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Essays in Female Labour Supply and Human Capital Formation in India

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Abstract

This thesis consists of three empirical essays analyzing socio-economic issues of policy relevance in the Indian context. Chapter 1 examines the role of the Indian caste system and perceived social discrimination in human capital formation over time. It investigates the evolution of gaps across social groups in India in children's cognitive outcomes and parental investment in children's education from age 5 to age 15 and studies how perceived social discrimination contributes to these observed gaps. Chapter 2 estimates the causal effect of having young children aged 0 to 5 years on mothers' labour force participation in rural India. It exploits Indian families' son-preferring fertility stopping behaviour to address the potential endogeneity in the fertility decision. Chapter 3 investigates the impact of prenatal sex diagnostic technology (PSDT), which was introduced in India in the post-economic liberalization period of the 1980s, on mothers' labour supply using a triple-differences estimator. It further investigates various underlying channels linking prenatal sex selection and mothers' labour supply.

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Introduction

This dissertation is composed of three papers in labour and development economics examining policy-relevant issues in 1) social identity, perceived social discrimination and human capital formation, 2) fertility and labour supply, and 3) Prenatal sex detection technology and mothers' labour supply, in the Indian context.

In chapter 1, titled "Castes, Perceived Discrimination, and Human Capital Formation in India", I examine the role of the Indian caste system and perceived social discrimination in human capital development in India from the age of 5 to 15 years. I look at human capital accumulation from two different perspectives- cognitive outcomes of children and parental investment in children's human capital. I find significant and persistent differences in children's test scores as well as parental investment between children belonging to lower vs. upper Hindu castes. These gaps cannot be completely explained by the differences in SES across castes. I also find that perceived social discrimination contributes to the gaps in human capital across castes. It hampers parental investment throughout childhood, but it negatively affects children's cognitive outcomes only at later ages. The findings of this paper have important implications from a policy perspective. They emphasize that the differences in cognitive outcomes observed across castes arise at a very early age and persist over time. Children belonging to lower castes are disadvantaged in terms of parental investments, more likely to drop out of school early, and are less likely to attend private schools. To bridge these gaps, there is a need for public policies that promote quality investment in children belonging to backward social groups at a very early age and discourage social discrimination.

In chapter 2, titled "Younger Children and Mothers' Labour Supply in Rural India: Evidence from Fertility Stopping Behaviour", I estimate the causal effect of the presence of young children aged 0 to 5 years on mothers' labour supply in rural India. To address the potential endogeneity in the fertility decision, I employ the Instrumental Variable strategy and exploit Indian families' preference for having sons. I leverage plausibly exogenous variation in the gender of older children aged 6+ years as an instrumental variable for having younger children aged 0 to 5 years in the family. I find that presence of children aged 0 to 5 years reduces mothers' labour supply by 10.2%. I discuss various concerns around conditional independence and exclusion restriction of the instrument, such as sex-selective abortions and differential behaviour of mothers in presence of existing sons vs daughters aged 6+, and show that the IV estimate is robust. Using heterogeneity analysis, I find that the negative effect of fertility on labour supply is driven by mothers with no education, belonging to wealthy, upper-caste Hindu and Muslim households. The findings of the paper highlight that mothers' labour market participation can be encouraged by investing in 1) skilled and female-friendly jobs with good remuneration; 2) quality formal childcare facilities; and 3) policies aiming to redefine the existing social norms that restrict women's economic participation and discourage gender stereotypes that lead to occupational segregation.

In chapter 3[1], titled "Prenatal Sex Detection Technology and Mothers' Labour Supply in India", we estimate the causal effect of prenatal sex detection technology (PSDT) on mothers' labour supply in India. The advent of prenatal sex diagnostic technology (PSDT) in India has made it easier for women to identify the sex of children before their birth, giving them an option to attain their desired sex composition of children without having to undergo repeated pregnancies. Following the waves of economic liberalization in the 1980s and 1990s, there was a supply-driven change in the availability of ultrasound technology. In the mid-1990s, large-scale domestic production of ultrasound scanners resulted in a marked increase in the availability of PSDT. In this paper, we use a triple-differences estimator to investigate the impact of this technology on mothers' labour supply. Our strategy combines supply-driven changes in ultrasound availability over time with plausibly exogenous family-level variation in the incentive to sex-select and son preference at the local level. We find that PSDT had a significant negative impact on mothers' labour supply. We further investigate various underlying channels linking prenatal sex selection and mothers' labour supply and identify two important channels: changes in fertility behaviour and increased investment in firstborn girls. We also find that the availability of PSDT mostly dampened the labour supply of illiterate mothers, mothers from poor, rural, and Hindu households- consistent with the hypothesis that labour force participation of poorly educated women and women from poor households is driven by necessity. With fewer unwanted daughters after the availability of ultrasound scans and decreased need to continue childbearing to attain desired sex composition of children resulting in exceeding of intended fertility, mothers' financial necessity to work reduces.

[1] Chapter 3 is a joint work with Marco Bertoni and Guglielmo Weber.

Chapter 1:

Castes, Perceived Discrimination, and Human Capital Formation in India

1.1 Introduction

In India, caste is a historically defined social identity which is inherited at birth. It plays a significant role in shaping economic mobility by defining access to resources and opportunities at every stage of an individual's economic and social life. There exists a wide heterogeneity across castes in terms of socioeconomic status, access to education, and access to the labour market. Children born in lower castes are exposed to disadvantaged environments while growing up, and there is evidence of marginalization, discrimination, and violence against certain social groups in India. Lower castes, in general, have been subjected to deep-rooted prejudices and social stigmatization in Indian society. For example, *Dalits*[2] – considered to be at the bottom of the Hindu caste hierarchy – were regarded as 'untouchables' and are often subjected to discriminatory and unequal treatment. It is well established that these early life experiences and living conditions may have lasting consequences on children's overall development, later life outcomes, and even inter-generational transmission of human capital (Attanasio et al., 2015; Cunha & Heckman, 2007; Rubio-Codina et al., 2016).

[2] *Dalits*, also called scheduled caste, is the lowest caste in hierarchy of the Indian caste system. Indian caste system is described in detail in section 1.2.

A growing body of empirical evidence suggests that children belonging to lower castes are inferior to children from upper castes in both physical and human capital outcomes such as health, educational attainment, and cognitive outcome. Most of these studies identify economic disadvantages faced by children belonging to lower castes as the major reason behind their poor development and later life outcomes (Banerjee & Knight, 1985; Borooah, 2012; Deshpande, 2001; Munshi, 2019).

However, little is known yet about the age at which these gaps in human capital start to emerge across castes and about their evolution as children age. Answering this question would bring crucial insights about the right age at which public policies aiming to bridge caste-based differences should target. This paper attempts to fill this void in the literature by analysing the dynamics of the role of castes in human capital formation during mid-childhood and early adolescence, between 5 and 15 years of age. I look at human capital accumulation from two different perspectives – cognitive outcomes of children and parental investment in children's human capital. I examine a wide range of indicators of both children's human capital stock and parental investment over time, including performance in various tests and material investment in education.

Furthermore, an understanding of the factors contributing to the unexplained differences across social groups is critical to moderate these inequalities. This paper looks at one such factor, namely perceived social discrimination. Firstly, I analyse how parents' perception of social discrimination affects their investments in children's education. And secondly, I examine whether there are differential effects of perceived social discrimination across social groups. This would indicate if perceived discrimination is one of the channels through which social identity affects human capital. I hypothesize that if parents perceive that they are discriminated against, then this lowers their expected returns to education, thus, lowering their investment in children's education. This channel is expected to be more prominent for the backward castes as the perception of social discrimination could aggravate the existing beliefs about discriminatory practices in the higher education and labour market, thus, disincentivizing parents from backward social groups to invest in children's education.

I also examine the effect of parents' perception of social discrimination on children's cognitive outcomes over time. Parents' perceptions about discrimination are likely to shape their children's understanding and perceptions of discrimination. For example, if parents concur that some store manager is acting discriminatory, then the child is more likely to make an attribution to discrimination than if his parents disagree with his perception.[3]

Unlike others in the literature, I do not estimate the contribution of discrimination to the observed gap in human capital between social groups using the Blinder-Oaxaca decomposition (for instance, see, Arouri et al., 2019; Banerjee & Knight, 1985; Borooah, 2012), as this approach has been criticized for understating or overstating the effect of discrimination (for instance, see, Madden, 2000; Munshi, 2019; Ospino et al., 2010). Thanks to the richness of my data, I instead use the self-reported measure of perceived social discrimination.[4]

Several studies in the US have analysed the racial gaps in the cognitive outcomes of children. For instance, Fryer & Levitt (2004, 2005) analysed the racial gaps in math and reading test scores during the early years of school. They find that the black-white test score gap among incoming kindergartners disappears after controlling for a small number of socioeconomic covariates. As they grow older, however, blacks lose substantial ground relative to other races. In addition, many studies in the US have extensively investigated the age when children start perceiving racial discrimination and its effect on cognitive outcomes (for instance, see, Brown & Bigler, 2005; Simons et al., 2002; Theimer et al., 2001). However, this paper is the first attempt to study these patterns across Indian social groups.

I utilize the Young Lives survey data, which is particularly well suited for this paper. Young Lives survey is longitudinal and followed 2011 children for 5 rounds at the ages of 1, 5, 8, 12, and 15, between 2002 and 2016. The data contains various pieces of information that are key for this analysis, such as children’s scores in PPVT[5], maths, english, and reading tests conducted at different ages; various measures of parental investment like expenditure on education related activities and type of school attended; a rich set of household and individual characteristics; measures of perceived social discrimination; among others.

[3] Understanding relations between perceptions of discrimination and children’s development has been identified as a key priority in both development and education economics literature (see, for instance, Brown, 2015; Brown & Bigler, 2005; Cheng et al., 2015; Stone & Han, 2005). Perceiving oneself to be the target of discrimination is likely to affect individuals' identity formation, peer relations, academic competencies, occupational goals, and mental and physical wellbeing (Brown & Bigler, 2005; Stone & Han, 2005).

[4] Using self-reported perceived discrimination also has some potential concerns, such as social-desirability bias, which I discuss in detail in section 4.3.

[5] The Peabody Picture Vocabulary Test (PPVT) is a widely used test to measure receptive vocabulary. The PPVT test is administered individually, orally, untimed, and norm-referenced, where the test taker selects the picture that best represents the meaning of a stimulus word presented orally by the examiner.

Recent literature has affirmed that the test scores are measured on ordinal scales.[6] As with utility functions, any monotonic transformation of the test score scale is also potentially a valid scale. Bond & Lang (2013) carry out a bounding exercise for Fryer & Levitt (2005) and show that order-preserving scale transformations of the test scores can provide contradictory conclusions about the growth in the gaps between Blacks and Whites- starting from increasing gaps over time to decreasing gaps over time and some transformations also suggesting that Blacks outperform Whites over time. In this paper, I deal with this issue of test scores ordinality by using percentile rankings of test scores which is scale-invariant.[7]

The findings of this paper suggest that there are substantial and persistent gaps in the test scores of children belonging to lower and upper-castes in India, throughout the 10 years of the study period. These gaps cannot be explained by the observed differences in SES across castes. As compared to the racial test score gaps, between blacks and whites, in the US reported by Fryer and Levitt (2005), caste-based test score gaps observed in this paper are smaller in magnitude but persistent over time. Besides, I also analyse the gaps between Muslims and Hindus and find that Muslims perform equally well in the PPVT test as upper-caste Hindus at the age of 5 and 8, but this gap becomes significant over time. However, in maths, english, and reading tests, Muslims perform worse than both upper and lower caste Hindus.

This paper also establishes that both lower caste Hindus and Muslims invest significantly less in the education of children, even after controlling for socioeconomic background, as compared to upper-caste Hindus. These gaps in parental investments across social groups are consistent over time. These children are more likely to drop out of school early and are also less likely to attend private and expensive schools.

Finally, this paper finds that perceived social discrimination plays a crucial role in human capital formation. It negatively affects parental investment in the education of children starting from a very early age, and the resulting gaps are persistent throughout the 10 years of the study period. On the contrary, the effect of perceived discrimination on test scores only appears as children age. This finding is consistent with the hypothesis that children develop an awareness of discrimination only as they grow older (Brown & Bigler, 2005). Results on differential effects of perceived social

[6] See, Cunha & Heckman (2008); Bond & Lang (2013)

[7] Discussed in detail in section 1.4.2.

discrimination across social groups suggest that it is a significant contributor to the differences in human capital observed across social groups.

The findings of this paper have important implications from a policy perspective. They emphasize that differences in cognitive outcomes observed across castes arise at a very early age and persist over time. Children belonging to lower castes are disadvantaged in terms of parental investments, more likely to drop out of school early, and are less likely to attend private schools. In order to bridge these gaps, there is a need for public policies that promote quality investment in children belonging to backward castes at a very early age and discourage social discrimination. The Government of India, through its Right to Education (RTE) Act, provides free primary education to socially and economically disadvantaged children through public schools, however, there is wide evidence in the literature that these schools are poor in quality (Gouda et al., 2013; Muralidharan & Kremer, 2006; Muralidharan & Sundararaman, 2013). Also, affirmative policies reserving seats for backward castes in higher education and public jobs are in place, but according to the findings of this paper, these policies may not help compensate for the gaps in human capital generated during critical periods of development in early life.

The rest of the paper proceeds as follows. Section two gives a brief background on the Indian caste system. Section three briefly discusses the related literature. Section four discusses the issue of test score ordinality. Section five describes the methodology, data, and descriptive statistics. Section six presents the main results and finally, section seven concludes with some policy discussions.

1.2 Background on Indian caste system

The Hindu caste system in India is a historical social stratification of people into various hierarchically ranked groups that were traditionally defined on the basis of professions. The existence of the caste system goes back to more than 2000 years ago. It comprises four hierarchical classes or *varnas*, namely- *Brahmins* (priests and teachers), the *Kshatriyas* (rulers and soldiers), the *Vaishyas* (merchants and traders), and the *Shudras* (labourers and artisans). Certain population groups, known as *Dalits*, were historically excluded from the varna system and were regarded as "untouchables". Each *varna* was further divided into hundreds of sub-castes called *jatis*, based on their specific occupation. The contemporary manifestation of the caste system comprises 6,000 endogamous *jatis* (Coffey et al., 2019).

Even though people have moved across occupations over time, the Indian caste system has persisted and is inherited at birth. Caste typically stays the same throughout the life of a person with some exceptions, such as women in inter-caste marriages take on the caste of their husbands and their children also inherit the caste from their fathers. However, marriages in India are mostly endogamous. Thus, an implicit social status is attached to a person by birth with limited mobility.

For political purposes and to provide relief and support to the backward social groups, in modern India, the Indian government introduced a new categorization scheme. *Dalits* or the untouchable castes were clubbed together and categorized as scheduled castes (SCs), socially and economically marginalized indigenous ethnic groups were categorized as scheduled tribes (STs), another group of castes that were identified as socioeconomically disadvantaged was referred to as other backward castes (OBCs), and rest of the other higher caste groups were referred to as upper/general castes.[8]

While the SCs are exclusive to Hindus, Sikhs, and Buddhists, STs and OBCs include some Muslim groups. ST Muslims are, however, relatively few in India and most Muslims fall under OBC or the general category. According to the Mandal Commission, which was established in 1979 to identify the socially or educationally backward classes of India, the backward Muslims made 8.4 percent out of the total 11.2 percent of the Indian Muslim population (Mondal, 2003).

These social groups are highly heterogeneous but, on average, lower castes like SCs, STs, and OBCs, have been disadvantaged in terms of income, education, and many other socioeconomic indicators. To address these disadvantages, untouchability was officially abolished in 1950[9] and compensatory, affirmative action in education and employment were introduced for scheduled castes and scheduled tribes who have suffered cumulative, social, and economic disabilities (Sankaran et al., 2017a). More recently in 1992, these benefits have been extended to other lower castes (OBCs) in response to their organized political assertion. Even after various affirmative actions, significant gaps persist across these social groups. There is evidence of substantial gaps in the level of schooling between lower and upper-castes; discriminatory practices and preconceptions

[8] Post-colonial India attempted to set up a democratic social order based on egalitarian ethos. Its constitutional policies were aimed at offsetting the disabilities faced by historically disadvantaged sections of population characterised as backward classes- SC, ST and OBC (Mondal, 2003).

[9] After several social movements to abolish the practice of untouchability, laws were made in the constitution to accommodate the interests of the oppressed classes. Article 17 of the Indian Constitution abolished untouchability and declared it as a punishable act. According to this, no one can restrict the *Dalits* from entering temples, streets, buses, etc. They are free to use all public services with respect and dignity. Also, no one can refuse from selling anything to the Dalit people. In spite of these constitutional amendments; untouchability, and caste discrimination still prevail in Indian society.

at school against lower caste; pre-market discrimination against lower castes; and labour market discrimination (Banerjee and Knight (1985), Munshi (2019), and Kijima (2006)).

1.3 Related literature

A growing body of literature globally suggests that the economic differences observed among individuals and households may have ethnic and racial origins. There is a large stream of literature demonstrating racial differences in the cognitive ability of young children, quality of schools attended, and school drop-out (Fryer & Levitt, 2004, 2005, 2013; Jones et al., 1984; Neal, 2006). Fryer and Levitt (2004, 2005) studied the racial gaps in maths and reading tests in the US and find that a substantial Black-White achievement gap exists at the entry to school which can be completely explained by differences in SES across races, and this gap increases with age and can no longer be explained by differences in SES. Arouri et al. (2019) find that in developing countries like Vietnam, Peru, and Ethiopia, children from small ethnic groups have lower educational attainment and cognitive ability.

In India, the lower castes have been socially disadvantaged for centuries. They were originally assigned the lowest-status occupations, requiring little investment in human capital, and even when they managed to achieve occupational mobility over time, they typically ended up in low-skill industrial jobs (Munshi, 2019). These differences continue to persist now and reinforce inequality throughout life as well as for the next generations.

Most of the studies in India have found significant differences in cognitive outcomes of children across castes. Disparities in factors like child health, parental education, household socioeconomic status, have been found to be important in explaining these gaps across castes in India. Other recent studies have found that even after controlling for the differences in initial endowments like socioeconomic endowments, the effects of these social institutions persist (Borooah, 2012; Munshi, 2019). For example, Munshi (2019) reviewing the literature on caste and Indian economy reports that even after controlling for parental education, household wealth, measures of school quality, and teacher inputs, SC/ST and OBC children are significantly less likely to attend school.

Gangopadhyay & Sarkar (2014) find that scheduled caste households invest significantly less than other households in private coaching of children, even after controlling for all available socioeconomic background variables. They posit these differences to be driven by the cultural paradigm as lower castes may be inherently less motivated to invest in education, for historical reasons.

Munshi & Rosenzweig (2006) analysed the schooling and career choices of children across castes in India with the advent of liberalization in the 1990s. There was a dramatic shift in the returns to different occupations and returns to learning English also increased, with greater access to white-collar jobs. They found that boys belonging to lower castes continued attending local language schools; whereas, for upper-caste children, an increase in enrolment at English-medium schools was observed.

Literature has also emphasized the contribution of caste-based discrimination, exclusion, and humiliation towards the underperformance of the lower caste children (Borooah (2012); Rawal and Kingdon (2010)). In an article, Singh & Husain (2016) argue that society's belief in the backwardness of certain communities has resulted in discrimination against them in the labour market, lowering perceived returns to education for such communities. They posit that these communities start behaving in a manner that justifies society's perceptions about them, reinforcing and perpetuating initial disparities (Singh & Husain, 2016). Thorat and Attewell (2007) conducted a field experiment to document caste-based pre-market discrimination against lower castes in the labour market and found that SC and Muslim candidates with identical educational qualifications and experience as upper-caste candidates were significantly less likely to be called for an interview.

In addition to social identity-based discrimination, there is also evidence of discrimination due to the economic status of one's parents, also known as class discrimination (Schiller, 1971). Xiang et al. (2018) studied Chinese migrants and found that children from lower-income families experienced greater discrimination than those with higher family incomes. In India, caste-based discrimination overlaps class-based discrimination. Lower social categories in India, especially scheduled castes, tribes, and Muslims, have disproportionality poorer than others and therefore, face relatively greater discrimination (Dhesi, 1998).

Studies from the developed countries have also shown that perceived discrimination is strongly associated with physical, mental, and behavioural health outcomes, such as depression, anxiety, chronic stress, post-traumatic stress disorder, and low self-esteem (Cheng et al., 2015; Cooke et al., 2014; Stone & Han, 2005; Xiang et al., 2018). For example, Brown & Bigler (2005) showed that children who experience discrimination from their teachers were more likely to have negative attitudes about school and lower academic motivation and performance, and were at increased risk of dropping out of high school.

The Government of India has made several provisions to bridge the caste-based gaps and safeguard the economic and social interests of the lower castes- SC, ST, and OBC- and address disparities in wages, employment, education, and consumption, for example, by providing up to 50% reservation of total available seats in universities, government jobs, political positions, etc, to the backward castes; and introducing 'Universal Education Program' (Sarva Shiksha Abhiyan), which targets the education of lower caste children through incentives like mid-day meal; establishment of new schools; and provision of scholarships to these children. Despite these efforts, caste-based differences are still persistent in India. It is, thus, important to understand the role of caste in the formation of human capital; the mechanisms through which caste channelizes its impact; and how this relationship evolves over time so that relevant policy measures can be taken to moderate these caste-based differences.

1.4 Empirical Framework

1.4.1 Data and descriptive statistics

The main objective of this paper is to understand how the role of caste and perceived social discrimination in human capital formation evolve during childhood. For carrying out the analysis, the ideal dataset would be one that provides detailed information on: children's cognitive outcomes and parental investment in children's education, measured at various ages; socioeconomic background such as caste, religion, and household wealth; and measure of perceived social discrimination.

In this paper, I utilize the younger cohort data from the Young Lives Survey (YL) which is particularly well suited for carrying out the analysis. The survey started in 2002 with two cohorts; younger cohort aged between 6 to 18 months and older cohort aged between 7.5 and 8.5 years. The sample of the younger cohort contains 2011 children and the data were collected in five rounds at ages 1, 5, 8, 12, and 15. Children were selected from the Hyderabad district and a 'poor' and a 'non-poor' district in each of the 3 distinct agro-climatic regions in Andhra Pradesh namely: Coastal Andhra, Rayalaseema, and Telangana, for a total of 7 districts.[10] Since the Young Lives survey aims

[10] Andhra Pradesh is a state in the south-eastern coastal region of India. It is the seventh-largest state by area and tenth-most populous state (approx. 49 million residents with 70% rural population). It comprises of two major regions, namely Rayalaseema and Coastal Andhra. Telangana is a neighbouring state of Andhra Pradesh and is the eleventh-

to document child poverty, it deliberately oversampled poor communities. As a result, while households from different socioeconomic backgrounds are included, the sample is not representative of the whole population.

In each round, an extensive effort was made to find and interview children who had moved from their location in the previous survey round. As a result, the attrition between rounds was very low. Total attrition from round 1 to round 5 was 5.9%. These figures include attrition due to mortality, with 2.14% of children dying between ages 1 to 15.

For analysis, I delineate the social groups by caste and religion. I construct four categories, namely, lower-caste Hindus- constituting Hindus belonging to SC, ST, and OBC; upper-caste Hindus-constituting Hindus belonging to forward/upper-castes; Muslims; and other religions.[11]

I construct an index for parents' perceived social discrimination using two survey questions asked to parents in round 2. Parents were asked to rate how much they agreed with the following two statements on a four-point Likert scale: 'When I am at shops/market I am usually treated with fairness and with respect by others' (called RESPECT henceforth); and 'Other people in my street/village look down on me and my family' (called LOOKED DOWN henceforth). These two manifestations of discrimination are combined to form an index for parents' perceived discrimination called 'DISCR'. This index takes a value of 0 if parents report no discrimination; and 1, if parents report facing either of the two manifestations of discrimination.[12]

I look at two key outcomes. The primary outcome variable is children's cognitive ability which I proxy using the scores obtained in PPVT, maths, english, language, and reading tests conducted by the YL interviewer in various rounds. Peabody Picture Vocabulary Test (PPVT) is a widely used receptive vocabulary test. In this test, the child is asked to select the picture that best represents the meaning of a stimulus word presented orally by the examiner. PPVT test was administered in all rounds starting from round 2 when children were 5 years old. Maths test scores, on the other hand, were administered in rounds 3, 4, and 5; these are, therefore, available at ages 8, 12, and 15. English

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largest state and the twelfth-most populated state in India (approx. 35 million residents with 61% rural population). Before 2014, Andhra Pradesh and Telangana formed a single state, however, in 2014 Telangana was carved off to form a separate state.

[11] As described in section 1.2, Muslim groups are not supposed to be included in the SCs category as it is restricted to Hindus, Sikhs and Buddhi and Muslim STs are relatively few. According to Mondal (2003), the Mandal Commission framed in 1980s treated 90 percent of Muslim population in the country as OBCs. Thus, in this paper I treat Muslims as a separate social group category and do not unpack castes within Muslims. Similarly, other religions constitute small share of population in India and are treated as a separate collective social group.

[12] The construction of this index is described in detail in the appendix

and reading test scores are available for rounds 4 and 5, respectively. The reading test was conducted on Telegu, which is a local and widely spoken language in Andhra Pradesh.

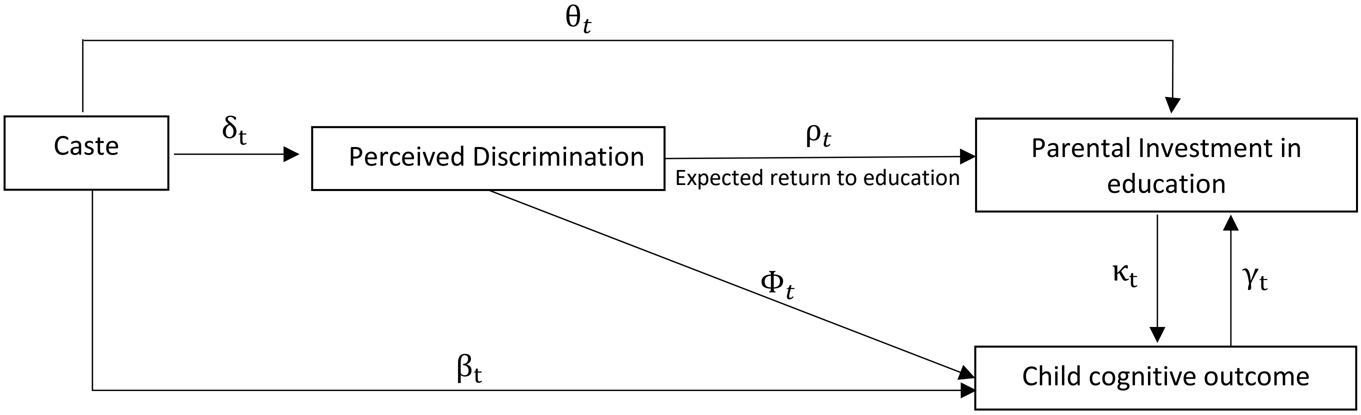
The second outcome variable is parental investment in education which is an important input in the process of human capital formation. Parents base their investment decisions on the returns to investments at different stages, the available resources, the prices of investment goods, and, importantly, on parents' beliefs about the child development process (Attanasio et al., 2015). I use the following measures of parental investment: expenditure by the household on education related commodities like school uniform, books, private tuitions; school fees; enrolment at school; and the type of school enrolled in (Private/Public); etc., in the last 12 months. All the investment variables have been deflated to 2002 prices and standardized with a mean of zero and a standard deviation of one.

In Figure 1.1, I demonstrate the plausible pathways between the variables of interest which gives a quick sense of how these variables are related. Caste may channelize its impact on children's cognitive and educational outcomes (a) directly through differences in initial endowments like socioeconomic status, parental education, and occupational status, etc, (b) indirectly via mediators like perceived discrimination and parental investment. Similarly, caste can potentially affect the parental investment in education (a) directly, (b) indirectly via our mediator of interest, perceived discrimination, and (c) indirectly by affecting children's cognitive outcomes, which in turn affect parents' investment decisions.

Table 1.1 presents descriptive statistics on children's household characteristics at the baseline (round 1). Around 76% live in rural communities, 54% of children are male, and the average household size is 5.4. Mothers are relatively young with an average age of 24. Mothers' education is also low with an average of just 3 years of education. 72.6% of the surveyed households are lower caste Hindus, 14% are upper-caste Hindus, and the remaining are Muslims and other religions.

In Table 1.2, I report additional statistics that vary across rounds. A significant fraction of the children suffers from stunting, wasting, and being underweight. Together, these indicators are suggestive of significant morbidity in this population. While the wealth index seems to be rising as the cohorts age (in part reflecting economic growth in the area), health indicators (height, weight, and BMI for age z scores) do not improve. Children spend minimal time working on household chores. By age 15, children spend approximately an hour a day helping out at home. Almost no children do paid work outside of the home. School enrolment increases from 22% at age 5 to 96% at age 12 and then decreases to 83% at age 15.

Figure 1.1: Plausible pathways between the variables of interest



Notes- This figure demonstrates the plausible pathways between the variables of interest.

Table 1.1: Descriptive statistics of the sample at baseline (round 1)

Variable	Mean	Std. Dev.	Min	Max
Gender= boy child	0.537	0.499	0	1
Region= urban	0.253	0.434	0	1
Lower caste Hindu (SC, ST and BC)	0.726	0.446	0	1
Upper-caste Hindu	0.143	0.349	0	1
Muslim	0.074	0.262	0	1
Other religions	0.057	0.231	0	1
Age in months	11.822	3.492	5	21
Household size	5.422	2.356	2	22
Mother's age	23.681	4.331	12	48
Mother's education	2.982	4.195	0	14
Children alive	1.892	0.999	1	8
Order of birth	1.979	1.116	1	11

Notes- This table presents descriptive statistics of the sample at baseline.

In Table 1.3, I report the initial endowments of children at the baseline across the four social groups.[13] The descriptive statistics provide suggestive evidence that children from backward castes are economically disadvantaged and, on average, exposed to challenging environments. Lower caste children belong to lower wealth families and have lower parental education. They also have a lower

[13] Table 1.3 reports descriptive statistics in round 1 (age 1) for all variables except school enrolment, which is reported for round 2 (age 5) because children are not enrolled in schools at the age of 1.

height for age z-score and are more likely to be stunted and underweight. Muslims on average are disadvantaged as compared to upper-caste Hindus but are better off than lower caste Hindus. Muslims on average start school late and have lower school enrolment at the age of 5 years as compared to other social groups. To check if some social groups are more likely to report social discrimination than others, I run a regression of perceived discrimination on caste- with and without controlling for income and wealth. The results are reported in Table 1.4. I find that after controlling for wealth and income, lower Hindu castes (SC, ST, and OBC) are 7% more likely to face discrimination as compared to upper-caste Hindus. Other religions, on the other hand, are 15% more likely to face discrimination as compared to upper-caste Hindus. There is also evidence of class-based discrimination with higher perceived discrimination among low-income families.

Table 1.2: Descriptive statistics across rounds

Variables	R1	R2	R3	R4	R5
Underweight	0.329	0.444	0.459	.	.
Stunting	0.307	0.357	0.289	0.292	0.278
Wasted/Thinness	0.188	0.187	0.273	0.330	0.255
Height for age Z-score	-1.337	-1.644	-1.425	-1.462	-1.468
Weight for age Z-score	-1.548	-1.866	-1.869	.	.
BMI for age Z-score	-1.038	-1.176	-1.414	-1.354	-1.138
Wealth index	0.408	0.459	0.514	0.585	0.633
Housing quality index	0.494	0.541	0.582	0.679	0.693
Access to services index	0.551	0.611	0.645	0.700	0.789
Consumer durables index	0.178	0.226	0.315	0.376	0.417
Access to electricity	0.821	0.898	0.965	0.976	0.980
Access to sanitation	0.299	0.327	0.347	0.407	0.497
Access to safe drinking water	0.838	0.949	0.967	0.989	0.992
Access to adequate fuels for cooking	0.245	0.270	0.299	0.428	0.686
Hours spent in paid activity per day	.	0.001	0.009	0.060	0.484
Hours of household chore per day	.	0.056	0.334	0.859	1.190
Hours at school per day	.	5.743	7.667	7.996	7.824
Hours of study per day	.	1.041	1.833	1.916	2.113
School Enrolment	.	0.218	0.935	0.963	0.878

Notes: This table provides descriptive statistics of the sample across YL rounds.

1.4.2 Ordinality of Test Scores

Recent literature has affirmed that the test scores are ordinal in nature and lack interval properties since these scores are monotonic transformations of some unobserved true measure of ability in a subject (Bond & Lang (2013), Lord (1975)). They provide a rank ordering of students but cannot measure by how much one student outperforms another. For example, the difference between a test score of 40 and 50 may be either more or less than the difference between a score of 70 and 80.

To understand how order-preserving monotonic transformations affect the evolution of gaps, Bond & Lang (2013) perform a bounding exercise on the black-white test score gap. They use an algorithm to generate monotonic transformations of the original test score scale to maximize and then minimize the growth of the test score gap and also maximize the correlation between kindergarten and third-year scores. They show that order-preserving scale transformations of these test scores can provide contradictory conclusions starting from increasing gaps over time to decreasing gaps over time and some transformations also suggesting that Blacks outperform Whites over time.

Table 1.3: Summary statistics for children belonging to various social groups

Sample Baseline	Full	Lower Hindu	Other Hindu	Muslim	Other religion
Height for age Z-score	-1.337	-1.458	-0.861	-1.133	-1.272
Wealth Index	0.408	0.364	0.538	0.586	0.405
Mother's education	2.982	2.169	6.049	5.013	3.009
Father's education	4.439	3.731	7.445	5.705	4.291
Stunting	0.307	0.343	0.168	0.216	0.327
Underweight	0.329	0.358	0.210	0.295	0.304
School enrolment at age 5	0.219	0.223	0.232	0.134	0.226

Notes: This table provides descriptive statistics of variables at the baseline, for all social groups. All the variables are from round 1, except for school enrolment which is reported for round 2.

Table 1.4: Perceived discrimination across castes

VARIABLES	(1)	(2)
Caste (Base- Upper Hindu)		
SC/ST/BC Hindu	0.114***	0.0683*
	(0.0391)	(0.0366)
Muslim	0.0468	0.0161
	(0.0575)	(0.0564)
Other religion	0.191**	0.155*
	(0.0835)	(0.0798)
Observations	1,928	1,924
R-squared	0.134	0.147
Income and Wealth controls	No	Yes
Location FE	Yes	Yes

*Notes: This table reports the estimates from regression of discrimination on castes. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

To deal with this issue of ordinality of scores, Cunha & Heckman (2008) and Bond & Lang (2018) propose anchoring test scores to adult outcomes such that the gaps are expressed in concrete units, such as completed years of education. As the adult outcomes are observed with significant delays, the primary challenge with this approach is the difficulty in the availability of relevant data.

In this paper, I transform the test scores in each round to percentile rankings which are scale-invariant. Percentile rankings are also invariant to changes in the scores that do not change ranks even though such modifications can change the relative means of the raw test scores. I estimate the gaps across castes at a given age as the difference in the mean percentile ranking. To maintain comparability with the literature on this subject, the test scores are standardized with a mean of zero and a standard deviation of one for the overall sample in each test and round.

Another solution, to estimate the test score gaps that are invariant to monotonic transformations, was recently proposed in a RES paper by Jeffery Penney (2017). The proposed method employs the ordinary least squares variant of unconditional quantile regressions (UQR) as developed by Firpo, Fortin, and Lemieux (2009) to estimate the test score gap at the median and then normalizes the coefficients of interest by dividing them with the standard error of the regression. This is in contrast to the usual method, which instead normalizes the coefficients by dividing them by the standard deviation of the dependent variable. I use this solution as a robustness check to verify that the test score gaps across castes over time are not just artefacts of test score scaling.

1.4.3 Estimation

To estimate the differences in children's cognitive outcomes and parental investment across social groups over time, I run the following regression model (1) separately for each YL round:

$$\boldsymbol{Y_{it} = \alpha_0 + \beta_t \, Social\ Group_i + \theta_t \, X_{it} + \gamma_i + \epsilon_{it}} \quad \textbf{(1.1)}$$

where, Y_{it} denotes the two outcome variables of interest- a) child i's percentile ranking in round t in various tests, and b) child i's standardized parental investment in round t. $Social\ Group_i$ is a full set of social groups dummies with upper-caste Hindu as the base category. X_{it} represents a parsimonious set of following socioeconomic controls: gender of the child; height by age score as a proxy for child health; birth order; sibling size; and socioeconomic status proxied by wealth index[14]

[14] Data on wealth index is provided in YL survey. It takes on a value between 0 and 1 and is constructed as an average of three indices: housing quality (quality of wall, roof, floor, and number of rooms/person), access to services (drinking

of the household, all at the baseline survey. γ_i represents the community level fixed effects, which controls for unobserved heterogeneity among the communities and ϵ_{it} is the random error term. Standard errors are clustered at the community level[15] to account for correlation in outcomes within communities.

First, I estimate the model without including socioeconomic controls (X_{it}). Consequently, β_t is the coefficient of interest which captures the raw gaps in outcome variables between the named caste category and upper Hindus in round t.

Next, I estimate the model with socioeconomic controls. Here, β_t captures the unexplained gaps in outcome variables across castes that cannot be explained by the differences in SES. It represents the additional penalty of being born in backward social groups, as opposed to being born in upper Hindu caste, that is not explained by other measures of socioeconomic disadvantage.

In papers such as Fryer & Levitt (2004), estimating the racial differences in children's test scores in the US, controls for parental education, parental employment, and household income are also included. However, one could argue that these controls are heritable and themselves outcomes of caste, which is the treatment in my analysis, making them bad controls. Hence, in my main specification, I do not include controls for these variables. However, I do carry out a robustness check by including these controls and the results remain unchanged.[16]

Next, to estimate the effect of perceived discrimination on the outcome variables, I run the following regression for each YL round.

$$\boldsymbol{Y_{it} = \alpha_0 + \beta_t \, Social\ Group_i + \delta_t Discr_i + \theta_t X_{it} + \gamma_i + \epsilon_{it}} \qquad \textbf{(1.2)}$$

where, $Discr_i$ is parents' perceived social discrimination index, with 'no discrimination' as the omitted category. It takes a value of 1 if parents perceive any manifestation of social discrimination, and 0, otherwise.

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water source, sanitation, cooking fuel, and electricity) and ownership of consumer durables (9 items such as- radio, television, motorbike, bicycle, automobile, landline, mobile phone, refrigerator, and fan) (Briones, 2017).

[15] Some children migrate over YL rounds to different communities, but I cluster standard errors at round 1 community level. This is done to maintain comparison among same children over time. I carry out some robustness checks which are detailed in section 1.6.1.

[16] The results from models controlling for household income and parental education are unchanged. I discuss robustness checks in detail in section 1.6.1.

I estimate equation (2), both with and without including socioeconomic controls (X_{it}). The coefficient of interest , δ_t, captures the effect of parents' perceived discrimination on outcome variables, holding the social group constant.

There are some concerns with using self-reported measures of perceived social discrimination. First, it may also pick up discrimination perceived due to one's class, or economic status. Estimating equation (2) including controls for SES addresses this concern as it captures the effect of discrimination holding one's economic status constant.

Second, there is a possible concern regarding 'social desirability bias'. Social desirability reflects the tendency of research subjects to claim or say things that are socially desirable and place the speaker in a favourable light. For instance, in the context of this paper, this may arise if parents under-report social discrimination because they might feel ashamed in acknowledging it. While I cannot rule out this concern, I note that in this case, the estimates on perceived social discrimination, controlling for caste, are attenuated. Another possibility is that parents of children who perform worse on tests are more likely to report discrimination. It is important to note that to alleviate this concern, I do not use a contemporaneous measure of perceived discrimination. As described in section 1.4.1, I use the earliest available perceived discrimination measure from round 2.

Specification (2) assumes that the effect of perceived discrimination on children's cognitive outcomes and parental investment is the same across social groups. As discussed in this paper before, some social groups are more likely to face discrimination as compared to others. I check if the influence of perceived discrimination on human capital and parental investment varies across social groups by estimating the following equation- both without and with socioeconomic controls.

$$\boldsymbol{Y_{it} = \alpha_0 + \beta_t\, Social\ Group_i + \delta_t Discr_i + \mu_t\, (Social\ Group_i \times Discr_i) + \theta_t\, X_{it} + \gamma_i + \epsilon_{it}} \qquad \textbf{(1.3)}$$

In equation (4), μ_t captures the additive effect of belonging to the named social group and facing discrimination as compared to the upper Hindu castes, and is the coefficient of interest. Or in other words, μ_t captured the differential effect of discrimination on human capital across social groups.

Finally, I test if the estimates on the gaps in human capital across social groups vary over survey rounds by using the seemingly unrelated estimation (SUEST) method developed by Weesie (2000).

1.5 Results

1.5.1 Cognitive ability

Table 1.5 presents a series of estimates of the gaps across social groups in percentile rankings in various tests, over YL survey rounds. To analyse how the gaps evolve over time, I compare if the coefficients across rounds are statistically different. The odd-numbered columns present the differences in mean percentile ranks in various tests, not controlling for any socioeconomic covariates. These results simply reflect the raw percentile rank gaps across social groups. Even-numbered columns present the estimates from specifications including SES controls.

At the age of 5 years, there is a significant raw percentile ranking difference of 0.31 standard deviations in the PPVT test between lower caste Hindus and upper-caste Hindus. This raw gap remains at 0.26 standard deviations at age 8, and 0.37 standard deviations at age 12 and 15. Once I introduce socioeconomic controls, significant gaps persist. At the age of 5 years, the gap in PPVT percentile ranking between lower and upper-caste Hindus after controlling for the covariates is 0.18 standard deviations, statistically significant at the 1% level and by the age of 15 years, this gap is 0.268 standard deviations. Results are reported in panel A of Table 1.5.

Next, I test for the equality of the estimates of PPVT percentile rank gaps across YL rounds, both with and without controls, and fail to reject the null hypothesis that the estimates are not significantly different across rounds, suggesting that the gap between lower and upper-caste Hindus in PPVT test remains constant over the 10 years of the study period.

Muslims, on the other hand, start off with a statistically insignificant deficit of 0.12 standard deviations, which disappears after controlling for the socioeconomic controls. However, over time they lose substantial ground relative to upper-caste Hindus and their PPVT percentile ranking deficit increases to 0.48 standard deviations by the age of 15 years, statistically significant at the 1% level, and the unexplained gap, after controlling for the socioeconomic background, remains at 0.39 standard deviations, significant at the 5% level, higher than that of lower Hindu castes.

Table 1.5b is identical to Table 1.5a but presents estimates from maths, english, and reading tests. Even after controlling for socioeconomic background, lower-caste Hindus rank 0.20 standard deviations below upper-caste Hindus in maths at the age of 8. There is evidence of a slight increase in this gap over time to 0.26 and 0.36 standard deviations by the age of 12 and 15 years, respectively. These gaps are statistically significant at the 1% level. Muslims perform consistently lower than both upper and lower Hindu castes in maths throughout the three YL rounds and rank 0.44, 0.47, and 0.40 standard deviations below upper-caste Hindus, all significant at the 1% level. These estimates for Muslims are not significantly different across rounds indicating that the gap is persistent over time.

As compared to racial gaps in maths test scores between blacks and whites in the US, as observed by Fryer & Levitt (2005), caste-based gaps in India are smaller in magnitude and are persistent over time. Fryer & Levitt (2005), on the other hand, found that the racial gap in kindergarten disappears after controlling for a small number of socioeconomic covariates, whereas over the three years of schooling, this gap increases significantly and can no longer be explained by the differences in SES across races.

In the english test conducted at the age of 12 years, lower-caste Hindus rank 0.27 standard deviations below upper-caste Hindus and Muslims are 0.39 standard deviations below upper-caste Hindus, after controlling for SES. In the reading test conducted at the age of 15 years, the gap is 0.26 and 0.38 standard deviations for lower caste Hindus and Muslims, respectively. All these estimates are statistically significant at the 1% level.

The results indicate that there are significant differences in the test scores of children across castes starting from a very early age and these gaps persist over time. Children belonging to lower Hindu castes on average perform significantly lower than upper-caste Hindus and Muslims perform worse than Hindus in general. These gaps cannot be completely explained by the differences in socioeconomic background and significant gaps remain when we control for the socioeconomic controls.

The controls in all the specifications enter with the expected sign. An increase in wealth at the baseline survey is associated with an improvement in children's performance in all the tests. Better health proxied by height by age z score is also associated with improvement in test scores of children. This suggests that socioeconomic background at an early age is a crucial determinant of human capital formation. I do not find any significant differences in the test scores of males and females.

Next, I estimate equation (2) for each YL round to capture the effect of parent's perceived discrimination on children's test scores. The estimation results are reported in Table 1.6. The results suggest that until the age of 8, parents' perception of social discrimination has no significant effect on children's performance in the PPVT test. However, starting from round 4, when children are aged 12 years, parents' perceived discrimination negatively affects the performance of children. Controlling for the social group, children of parents perceiving discrimination rank 0.19 standard deviation below as compared to children whose parents do not perceive discrimination in the PPVT test. This gap remains at 0.12 in round 5. When the difference in SES background is accounted for, this gap is 0.18 standard deviations in round 4 and 0.10 in round 5. These estimates across rounds 4 and 5 are not statistically different from each other, suggesting that the effect of perceived discrimination persists. These results are consistent with the fact that as children age they develop awareness about discrimination and it negatively affects their academic performance. For example, Brown & Bigler (2005) report that in the US, most children (92%) are familiar with the meaning of discrimination by the age of 10.

Similarly, children whose parents report facing discrimination also score substantially lower in maths and english tests. The raw maths percentile ranking gaps between children whose parents perceive discrimination and children whose parents perceive no discrimination are 0.15, 0.13, and 0.17 standard deviations at age 8, 12, and 15, respectively. When I control for SES background, these deficits are 0.11, 0.09, and 0.14. These gaps across rounds are not statistically different from each other.

In the english test, conducted at age 12, this deficit is 0.20 and 0.15 standard deviations, without and with SES controls, respectively. I do not find any significant effect of perceived discrimination on reading tests conducted at age 15 which could be because the reading test was conducted on Telegu which is the local and widely spoken language in the state of Andhra Pradesh. Overall, the results confirm that perceived social discrimination negatively affects the cognitive development of children as they grow older.

Next, I estimate equation (3) to capture the differential effect of discrimination across social groups. The estimation results are reported in Table 1.7. All the regressions control for socioeconomic characteristics. For upper-caste Hindus, there is no significant effect of perceived discrimination on PPVT test scores. There seems to be no effect of discrimination on the maths, english, and reading test scores of upper-caste Hindus as well, except for maths test scores at age 8, which is significant only at the 10% level.

For lower caste Hindus, discrimination significantly negatively affects children's performance in the PPVT test at the age of 12 and this effect statistically remains constant at age 15. Lower caste

Hindus facing discrimination score 0.20 standard deviations below upper-caste Hindus facing no discrimination at age 12, and this gap remains at 0.08 standard deviations at age 15. The effect of discrimination on lower caste Hindus is significant also in maths, english, and reading tests. These results suggest that perception of social discrimination disproportionately affects test scores of lower Hindu castes. Perceived discrimination seems to be a significant contributor to the differences in cognitive outcomes observed between lower and upper-caste Hindus. This may be because lower castes have been subjected to discrimination in access to skills, higher education, and the labour market. Perception of social discrimination among lower castes may further aggravate these existing beliefs about discrimination, lowering their expected returns to education and labour market and thus, disproportionately affecting their outcomes. For Muslims, I do not find any significant effect of perceived discrimination on their cognitive outcomes.

1.5.2 Parental Investment

Table 1.8 presents the estimates of differences in parental investment in children's education across social groups over time. The odd-numbered columns report the raw differences in the investments across social groups without controlling for socioeconomic factors while the even-numbered columns control for socioeconomic covariates.

The estimates from panel A of Table 1.8 suggest that lower caste Hindus invest significantly less in children's education as compared to upper-caste Hindus. These investment gaps are constant over time. At the age of 5 years, the raw gap in investment between lower caste Hindus and upper-caste Hindus is 0.52 standard deviations and it is 0.39 standard deviations at the age of 15. These estimates across rounds are not statistically significantly different, suggesting that the gap in children's expenditure is persistent over time. After controlling for socioeconomic background, the gap is 0.34 standard deviations at age 5 and the gap remains statistically constant over time and is 0.45, 0.30, and 0.30 in the subsequent rounds. All the estimates are statistically significant at the 1% level.

Muslim parents invest further less in the education of children. The raw investment gap in Muslims and upper-caste Hindus is 0.64 standard deviations at age 5 and remains statistically constant throughout. After controlling for the covariates, this investment gap is 0.54 standard deviations at the age of 5 and 0.48 standard deviations at the age of 15.

Parents belonging to other religions like Christian, Jain, Sikh, etc, also invest significantly less in the education of children relative to upper-caste Hindus.

Table 1.5: Test score gaps across social groups over time

Panel A:	**Standardized PPVT percentiles**							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.321***	-0.178***	-0.263***	-0.140*	-0.371***	-0.213***	-0.373***	-0.268***
	(0.066)	(0.061)	(0.084)	(0.081)	(0.066)	(0.063)	(0.079)	(0.079)
Muslim	-0.122	-0.018	-0.320*	-0.244	-0.648***	-0.553***	-0.476***	-0.392**
	(0.131)	(0.129)	(0.165)	(0.150)	(0.157)	(0.153)	(0.165)	(0.174)
Other religion	-0.201*	-0.058	-0.197	-0.050	-0.320**	-0.130	-0.458***	-0.324***
	(0.116)	(0.111)	(0.137)	(0.120)	(0.123)	(0.106)	(0.129)	(0.121)
Observations	1,851	1,832	1,901	1,879	1,903	1,881	1,890	1,867
SES controls	No	Yes	No	Yes	No	Yes	No	Yes

Panel B: Standardized Percentiles			**Maths**				**English**		**Reading**	
	Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Caste (Base- Upper Hindu)										
SC/ST/BC Hindu	-0.359***	-0.197***	-0.446***	-0.264***	-0.496***	-0.355***	-0.480***	-0.273***	-0.367***	-0.245***
	(0.057)	(0.054)	(0.068)	(0.072)	(0.090)	(0.091)	(0.080)	(0.076)	(0.075)	(0.075)
Muslim	-0.547***	-0.442***	-0.600***	-0.474***	-0.514***	-0.423***	-0.523***	-0.393***	-0.453***	-0.379***
	(0.107)	(0.100)	(0.130)	(0.129)	(0.113)	(0.103)	(0.126)	(0.117)	(0.099)	(0.102)
Other religion	-0.359***	-0.184*	-0.383***	-0.195**	-0.440***	-0.278**	-0.451***	-0.244**	-0.380***	-0.242**
	(0.133)	(0.106)	(0.121)	(0.093)	(0.125)	(0.117)	(0.117)	(0.102)	(0.110)	(0.103)
Observations	1,904	1,883	1,858	1,838	1,840	1,818	1,862	1,842	1,831	1,810
SES controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.6: Effect of discrimination on children's test scores

Panel A:	Standardized PPVT percentiles							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.308***	-0.170***	-0.250***	-0.132	-0.368***	-0.221***	-0.370***	-0.271***
	(0.067)	(0.062)	(0.086)	(0.083)	(0.064)	(0.061)	(0.078)	(0.079)
Muslim	-0.110	-0.012	-0.302*	-0.229	-0.644***	-0.558***	-0.470***	-0.394**
	(0.125)	(0.122)	(0.164)	(0.148)	(0.153)	(0.150)	(0.168)	(0.175)
Other religion	-0.190	-0.053	-0.170	-0.037	-0.305**	-0.131	-0.454***	-0.332***
	(0.115)	(0.110)	(0.143)	(0.123)	(0.122)	(0.107)	(0.130)	(0.122)
Perceived social discrimination	0.002	0.029	-0.070	-0.045	-0.194***	-0.178***	-0.117*	-0.098
	(0.055)	(0.055)	(0.045)	(0.043)	(0.062)	(0.059)	(0.061)	(0.061)
Observations	1,833	1,815	1,879	1,859	1,881	1,861	1,868	1,848
SES Controls	No	Yes	No	Yes	No	Yes	No	Yes

Panel B: Standardized Percentiles	Maths						English		Reading	
	Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Caste (Base- Upper Hindu)										
SC/ST/BC Hindu	-0.342***	-0.191***	-0.425***	-0.253***	-0.482***	-0.351***	-0.449***	-0.251***	-0.342***	-0.230***
	(0.058)	(0.055)	(0.070)	(0.074)	(0.091)	(0.092)	(0.078)	(0.076)	(0.075)	(0.075)
Muslim	-0.524***	-0.428***	-0.581***	-0.462***	-0.507***	-0.423***	-0.492***	-0.371***	-0.435***	-0.370***
	(0.107)	(0.100)	(0.128)	(0.127)	(0.111)	(0.104)	(0.123)	(0.116)	(0.098)	(0.101)
Other religion	-0.323**	-0.169	-0.361***	-0.177*	-0.427***	-0.272**	-0.404***	-0.200*	-0.337***	-0.213**
	(0.135)	(0.107)	(0.121)	(0.095)	(0.130)	(0.121)	(0.120)	(0.107)	(0.108)	(0.099)
Perceived social discrimination	-0.148***	-0.112**	-0.134**	-0.091	-0.169***	-0.145***	-0.200***	-0.153***	-0.089	-0.069
	(0.047)	(0.047)	(0.063)	(0.058)	(0.055)	(0.052)	(0.059)	(0.054)	(0.064)	(0.063)
Observations	1,882	1,863	1,837	1,818	1,819	1,800	1,842	1,823	1,810	1,792
SES Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.7: Differential effect of discrimination on test scores across social groups over time

	Standardized Test Scores								
	PPVT				Maths			English	Reading
	Age 5	Age 8	Age 12	Age 15	Age 8	Age 12	Age 15	Age 12	Age 15
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Base- Upper Hindus × No Discr									
Lower Hindu × No Discr	-0.181***	-0.094	-0.175**	-0.302***	-0.093	-0.209***	-0.335***	-0.217***	-0.230***
	(0.069)	(0.091)	(0.072)	(0.076)	(0.062)	(0.079)	(0.097)	(0.076)	(0.081)
Muslim × No Discr	-0.080	-0.230	-0.484***	-0.396*	-0.376***	-0.431***	-0.381***	-0.347***	-0.348***
	(0.128)	(0.156)	(0.180)	(0.201)	(0.128)	(0.137)	(0.111)	(0.120)	(0.124)
Other religion × No Discr	-0.048	-0.017	-0.115	-0.376**	-0.069	-0.183	-0.301***	-0.186	-0.202*
	(0.125)	(0.140)	(0.140)	(0.151)	(0.117)	(0.119)	(0.114)	(0.134)	(0.106)
Upper Hindu × Discr	-0.034	0.076	-0.006	-0.207	0.231*	0.058	-0.088	-0.033	-0.060
	(0.161)	(0.151)	(0.139)	(0.170)	(0.139)	(0.149)	(0.187)	(0.167)	(0.153)
Lower Hindu × Discr	-0.159*	-0.168*	-0.371***	-0.382***	-0.259***	-0.332***	-0.489***	-0.391***	-0.291***
	(0.086)	(0.093)	(0.098)	(0.085)	(0.072)	(0.091)	(0.100)	(0.094)	(0.106)
Muslim × Discr	0.155	-0.177	-0.796***	-0.568**	-0.407***	-0.516***	-0.630***	-0.494***	-0.493***
	(0.153)	(0.239)	(0.186)	(0.224)	(0.135)	(0.163)	(0.170)	(0.187)	(0.172)
Other religion × Discr	-0.073	-0.039	-0.224	-0.421***	-0.230	-0.147	-0.320	-0.294*	-0.299
	(0.183)	(0.157)	(0.157)	(0.145)	(0.192)	(0.174)	(0.206)	(0.157)	(0.182)
Observations	1,815	1,859	1,861	1,848	1,863	1,818	1,800	1,823	1,792
SES controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Panel B of Table 1.8 reports the estimates of the differences in expenditure on school fees across castes in rounds 4 and 5, conditional on enrolment at school. The results indicate that lower caste Hindus spend significantly less on school fees as compared to upper-caste Hindus suggesting that upper-caste Hindus, in general, attend expensive schools.

After controlling for the SES, the difference in the annual school fees paid by the parents belonging to these two social groups is 0.38 and 0.40 standard deviations in rounds 4 and 5, respectively. The corresponding gap between Muslims and upper-caste Hindus is 0.50 and 0.34 standard deviations in rounds 4 and 5, respectively.

There are no significant differences in the enrolment at school across social groups until round 3. However, by the age of 15, children belonging to lower Hindu castes and Muslims are 7% and 10% less likely to attend school as compared to upper Hindu castes, respectively. The results suggest that Muslims and lower-caste Hindus drop out of school early.

The estimates on differences in the type of school attended by children across castes, conditional on enrolment at school are reported in Table 1.8, Panel C. Even after controlling for the socioeconomic differences, there are significant differences across social groups in the type of school children attend. The gaps are constant over time and lower-caste Hindus are 20% less likely to attend private schools- which are comparatively better and more expensive as compared to public schools- than their upper-caste Hindu counterparts. For Muslims, this difference is 32% at age 5 and 15% at age 15.

Next, I estimate equation (2) for parental investment. The results are reported in Table 1.9. The estimates from Panel A suggest that even after controlling for the social group and other observables, perceived discrimination negatively affects parents' investment in children's education. Parents perceiving discrimination invest 0.16 standard deviations less as compared to parents perceiving no discrimination in round 2. The estimate is statistically significant at the 1% level. In round 3 when children are 8 years old, the estimate on perceived discrimination is insignificant. By rounds 4 and 5, the gap in investment between parents perceiving discrimination and parents perceiving no discrimination is 0.23 and 0.09 standard deviations significant at the 1% and 5% level, respectively.

Results in Panel B suggest that even after controlling for the observed SES covariates, parents perceiving discrimination spend around 0.10 standard deviations less on school fees as compared to parents perceiving no discrimination in rounds 4 and 5. Both the estimates are statistically significant. Parents' perceived discrimination has no significant effect on school attendance until round 4 but in round 5 discrimination reduces school enrolment by 5%, suggesting that children belonging to parents perceiving discrimination are significantly more likely to drop out of school by age 15, or in other words, perceived discrimination leads to earlier school drop-outs of children.

Estimates reported in Panel C suggest that conditional on enrolment at school, perceived social discrimination significantly affects the likelihood of attending private schools. Controlling for SES, at the age of 5, children are 15% less likely to attend private school if their parents perceive discrimination. This gap is 7%, 5%, and 7% in rounds 3, 4, and 5, respectively.

Finally, I estimate equation (3) to see if perceived discrimination affects parental investment across social groups differently. The results are reported in Table 1.10. All the regressions include controls for socioeconomic status. Overall, I find that there is no significant effect of discrimination on upper-caste Hindus. For lower caste Hindus, discrimination plays a crucial role and reduces parental investment in the education of children. Parents belonging to lower Hindu castes who perceive discrimination invest significantly less in education, spend less on school fees, and are less likely to send children to private schools, as compared to lower-caste Hindus who do not perceive discrimination. For Muslims, I find a significant negative effect of perceived discrimination on school enrolment in all rounds, except for round 3 in which the coefficient is statistically insignificant.

This differential effect of perceived social discrimination across social groups could be because the perception of social discrimination among backward castes aggravates parents' existing belief about discriminatory practices in access to skills, higher education, and labour market, thus, disincentivizing parents to invest in children's education and perpetuating social inequality over generations for backward castes.

1.5.3 Analysis within-lower Hindu castes

I also carry out the analysis within lower Hindu castes to estimate the differences in cognitive outcomes and parental investment in education across Scheduled Caste, Scheduled Tribes, and Other Backward Caste (OBC). Tables 1.11 and 1.12 report the results for test scores and parental investment, respectively.

There are no differences in percentile rankings in tests across SCs, STs, and OBCs. With respect to perceived discrimination, there is no significant effect of discrimination on PPVT test scores at the age of 5 and 8. However, at age 12, discrimination reduces PPVT percentile ranking by 0.20 standard deviations, significant at the 1% level. At the age of 15 years, the effect is again insignificant.

With respect to parental investment, SCs and STs spend significantly less on children's education in the early years, but there are no significant differences in expenditure across castes in the last two rounds, i.e. at age 12 and 15. SCs spend significantly less on school fees. However, there is no significant difference in school fees paid between OBCs and STs. There are no differences in school enrolment across SCs, STs, and OBCs. And finally, SCs are significantly less likely to attend private school as compared to OBCs and STs.

Parents' perception of discrimination within lower castes significantly lowers expenditure on education, enrolment at school, and attendance at private schools.

1.6 Robustness Checks

1.6.1 Sensitivity of results

I conduct a number of robustness checks to test the sensitivity of my estimates to different specifications of the model. Firstly, I test whether the estimates are sensitive to the inclusion of other SES controls like family income and parental education. This follows from the discussion before about these variables being themselves outcomes of caste, making them bad controls. Reassuringly, the estimates from specifications including the above controls mirror the estimates from the main specification.

Next, since some children migrated over time to other places, I also tried specifications with round specific location fixed effects and the results are robust. I also carry out analysis for a subsample excluding children who migrated outside their sentinel site over time to avoid comparison of children who migrated with children who did not migrate, as migration could be an endogenous choice. The results are reported in Table A1.1 of the appendix. The estimates are robust and mirror the results from the main specification reported in Table 1.5 and Table 1.8.

Additionally, I check if gaps in cognitive outcomes and parental investment observed over time across social groups and the manifestation of perceived discrimination persist if controls for children's initial cognitive ability are included. The estimates are reported in Table A1.2 and A1.3 in the appendix. The estimates capture differences in children's test scores and parental investment in successive rounds across social groups conditional on lagged PPVT score of round 2.

Table 1.8: Parental investment gaps across castes

Panel A:	Annual Expenditure on Education							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.523***	-0.347***	-0.611***	-0.446***	-0.422***	-0.302***	-0.389***	-0.297***
	(0.099)	(0.103)	(0.111)	(0.101)	(0.115)	(0.111)	(0.086)	(0.086)
Muslim	-0.642***	-0.542***	-0.692***	-0.594***	-0.446***	-0.391***	-0.512***	-0.482***
	(0.093)	(0.090)	(0.135)	(0.125)	(0.128)	(0.119)	(0.083)	(0.079)
Other religion	-0.452***	-0.262*	-0.680***	-0.511***	-0.358*	-0.229	-0.384***	-0.281**
	(0.163)	(0.155)	(0.121)	(0.101)	(0.207)	(0.208)	(0.106)	(0.113)
Observations	1,484	1,463	1,893	1,870	1,788	1,767	1,763	1,742
SES controls	No	Yes	No	Yes	No	Yes	No	Yes

Panel B:	School Fees				Enrolment at school							
	Age 8 (Round 3)		Age 12 (Round 4)		Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Caste (Base- Upper Hindu)												
SC/ST/BC Hindu	-0.532***	-0.375***	-0.507***	-0.395***	0.007	0.009	-0.006	-0.009	-0.028**	-0.019	-0.093***	-0.065**
	(0.109)	(0.108)	(0.093)	(0.091)	(0.034)	(0.036)	(0.017)	(0.017)	(0.013)	(0.013)	(0.023)	(0.025)
Muslim	-0.600***	-0.499***	-0.381***	-0.336**	-0.013	-0.016	-0.016	-0.024	-0.006	0.003	-0.119***	-0.099***
	(0.120)	(0.116)	(0.132)	(0.133)	(0.054)	(0.053)	(0.025)	(0.028)	(0.017)	(0.017)	(0.040)	(0.038)
Other religion	-0.661***	-0.493***	-0.523***	-0.396***	-0.028	-0.029	0.031	0.024	-0.015	-0.005	-0.038	-0.003
	(0.113)	(0.108)	(0.093)	(0.097)	(0.054)	(0.057)	(0.022)	(0.022)	(0.016)	(0.017)	(0.033)	(0.033)
Observations	1,839	1,818	1,657	1,638	1,931	1,908	1,931	1,908	1,920	1,896	1,900	1,876
SES controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Panel C:	**Type of School (Private School)**							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.277***	-0.222**	-0.277***	-0.182***	-0.279***	-0.202***	-0.267***	-0.194***
	(0.089)	(0.088)	(0.049)	(0.045)	(0.042)	(0.039)	(0.042)	(0.039)
Muslim	-0.332**	-0.321**	-0.250***	-0.185***	-0.299***	-0.244***	-0.188**	-0.155**
	(0.157)	(0.161)	(0.059)	(0.057)	(0.049)	(0.044)	(0.077)	(0.077)
Other religion	-0.388***	-0.326***	-0.288***	-0.187***	-0.326***	-0.239***	-0.270***	-0.188***
	(0.092)	(0.087)	(0.078)	(0.063)	(0.062)	(0.047)	(0.057)	(0.052)
Observations	422	416	1,806	1,784	1,839	1,818	1,658	1,639
SES controls	No	Yes	No	Yes	No	Yes	No	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.9: Effect of discrimination on parental investment

Panel A:	**Annual Expenditure on Education**							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.514***	-0.350***	-0.614***	-0.450***	-0.410***	-0.294***	-0.326***	-0.241***
	(0.100)	(0.105)	(0.112)	(0.102)	(0.115)	(0.111)	(0.080)	(0.080)
Muslim	-0.639***	-0.550***	-0.700***	-0.599***	-0.441***	-0.388***	-0.436***	-0.413***
	(0.095)	(0.093)	(0.140)	(0.129)	(0.129)	(0.120)	(0.106)	(0.103)
Other religion	-0.444***	-0.263*	-0.674***	-0.502***	-0.326	-0.202	-0.316***	-0.220*
	(0.164)	(0.157)	(0.123)	(0.103)	(0.211)	(0.211)	(0.107)	(0.114)
Perceived social discrimination	-0.201***	-0.161***	-0.100*	-0.052	-0.277***	-0.233***	-0.135***	-0.092**
	(0.054)	(0.053)	(0.054)	(0.052)	(0.054)	(0.051)	(0.042)	(0.038)
Observations	1,467	1,447	1,872	1,851	1,770	1,751	1,744	1,725
SES controls	No	Yes	No	Yes	No	Yes	No	Yes

Panel B:	**School Fees**				**Enrolment at school**							
	Age 12 (Round 4)		Age 15 (Round 5)		Age 5 (Round 2)		Age 85 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Caste (Base- Upper Hindu)												
SC/ST/BC Hindu	-0.486***	-0.337***	-0.424***	-0.319***	0.011	0.015	-0.003	-0.006	-0.026**	-0.018	-0.088***	-0.061**
	(0.109)	(0.107)	(0.094)	(0.092)	(0.035)	(0.036)	(0.017)	(0.017)	(0.013)	(0.014)	(0.023)	(0.025)
Muslim	-0.561***	-0.462***	-0.283	-0.243	-0.007	-0.009	-0.015	-0.023	-0.004	0.004	-0.114***	-0.095**
	(0.115)	(0.111)	(0.220)	(0.218)	(0.057)	(0.056)	(0.025)	(0.028)	(0.018)	(0.018)	(0.039)	(0.037)
Other religion	-0.613***	-0.449***	-0.438***	-0.318***	-0.015	-0.018	0.031	0.026	-0.013	-0.003	-0.023	0.004
	(0.114)	(0.110)	(0.103)	(0.107)	(0.055)	(0.057)	(0.023)	(0.022)	(0.016)	(0.017)	(0.033)	(0.034)
Perceived social discr	-0.151***	-0.105**	-0.127**	-0.092*	-0.033	-0.033	0.012	0.014	-0.019	-0.016	-0.052**	-0.045**
	(0.047)	(0.045)	(0.048)	(0.047)	(0.024)	(0.024)	(0.013)	(0.014)	(0.013)	(0.014)	(0.020)	(0.020)
Observations	1,818	1,799	1,639	1,622	1,909	1,888	1,909	1,888	1,897	1,876	1,878	1,857
SES Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Panel C:	**Type of School (Private School)**							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.301***	-0.247***	-0.263***	-0.173***	-0.270***	-0.196***	-0.255***	-0.187***
	(0.090)	(0.090)	(0.049)	(0.044)	(0.043)	(0.040)	(0.042)	(0.040)
Muslim	-0.301*	-0.282*	-0.238***	-0.178***	-0.295***	-0.243***	-0.185**	-0.157**
	(0.164)	(0.169)	(0.058)	(0.057)	(0.049)	(0.045)	(0.075)	(0.075)
Other religion	-0.404***	-0.343***	-0.262***	-0.164**	-0.309***	-0.224***	-0.249***	-0.171***
	(0.091)	(0.088)	(0.080)	(0.065)	(0.065)	(0.052)	(0.057)	(0.054)
Perceived social discrimination	-0.147***	-0.150***	-0.096***	-0.068***	-0.075***	-0.048*	-0.088***	-0.072***
	(0.054)	(0.055)	(0.025)	(0.023)	(0.026)	(0.026)	(0.027)	(0.027)
Observations	417	411	1,787	1,767	1,818	1,799	1,640	1,623
R-squared	0.575	0.602	0.361	0.448	0.288	0.357	0.258	0.310

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.10: Differential effect of discrimination on parental investment across castes

Panel A:	**Expenditure on education**				**School Fees**	
	Age 5	Age 8	Age 12	Age 15	Age 12	Age 15
	(1)	(2)	(3)	(4)	(5)	(6)
Base- Upper Hindus × No Discr						
Lower Hindu × No Discr	-0.365**	-0.400***	-0.333**	-0.253**	-0.343***	-0.320***
	(0.148)	(0.101)	(0.132)	(0.098)	(0.116)	(0.108)
Muslim × No Discr	-0.586***	-0.598***	-0.417***	-0.457***	-0.406***	-0.242
	(0.129)	(0.147)	(0.142)	(0.115)	(0.122)	(0.262)
Other religion × No Discr	-0.225	-0.447***	-0.227	-0.166	-0.464***	-0.316**
	(0.219)	(0.118)	(0.280)	(0.149)	(0.124)	(0.127)
Upper Hindu × Discr	-0.209	0.118	-0.372***	-0.135	-0.111	-0.094
	(0.245)	(0.281)	(0.134)	(0.110)	(0.147)	(0.179)
Lower Hindu × Discr	-0.515***	-0.485***	-0.544***	-0.336***	-0.431***	-0.410***
	(0.146)	(0.123)	(0.126)	(0.091)	(0.125)	(0.111)
Muslim × Discr	-0.656***	-0.524***	-0.653***	-0.418***	-0.727***	-0.340**
	(0.205)	(0.148)	(0.143)	(0.146)	(0.132)	(0.162)
Other religion × Discr	-0.567***	-0.540***	-0.485***	-0.444***	-0.528***	-0.416***
	(0.148)	(0.136)	(0.177)	(0.115)	(0.147)	(0.141)
Observations	1,447	1,851	1,751	1,725	1,799	1,622
SES controls	Yes	Yes	Yes	Yes	Yes	Yes

Panel B:	Enrolment at school				Private School			
	Age 5	Age 8	Age 12	Age 15	Age 5	Age 8	Age 12	Age 15
	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)
Base- Upper Hindus × No Discr								
Lower Hindu × No Discr	0.031	-0.002	-0.005	-0.045*	-0.278***	-0.175***	-0.229***	-0.201***
	(0.038)	(0.020)	(0.015)	(0.026)	(0.101)	(0.041)	(0.042)	(0.045)
Muslim × No Discr	-0.055	-0.044	0.011	-0.061	-0.277	-0.184***	-0.230***	-0.172**
	(0.043)	(0.034)	(0.014)	(0.038)	(0.235)	(0.053)	(0.043)	(0.081)
Other religion × No Discr	0.012	0.017	0.002	-0.007	-0.355***	-0.154**	-0.247***	-0.150**
	(0.065)	(0.029)	(0.021)	(0.045)	(0.105)	(0.074)	(0.062)	(0.063)
Upper Hindu × Discr	0.009	0.016	0.031*	0.018	-0.257*	-0.073	-0.151**	-0.118*
	(0.055)	(0.025)	(0.016)	(0.030)	(0.141)	(0.075)	(0.071)	(0.068)
Lower Hindu × Discr	-0.022	0.002	-0.029	-0.098***	-0.393***	-0.241***	-0.250***	-0.261***
	(0.042)	(0.021)	(0.020)	(0.032)	(0.119)	(0.046)	(0.045)	(0.047)
Muslim × Discr	0.111	0.047*	0.007	-0.181**	-0.480***	-0.235**	-0.411***	-0.222**
	(0.119)	(0.024)	(0.039)	(0.072)	(0.160)	(0.102)	(0.106)	(0.103)
Other religion × Discr	-0.079	0.058**	0.002	0.020	-0.546***	-0.252***	-0.300***	-0.313***
	(0.073)	(0.023)	(0.029)	(0.042)	(0.101)	(0.086)	(0.068)	(0.068)
Observations	1,888	1,888	1,876	1,857	411	1,767	1,799	1,623
SES controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects and SES. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.11: Test score percentile ranking gaps across SCs, STs, and OBCs

	PPVT				Maths			English	Reading
	Age 5	Age 8	Age 12	Age 15	Age 8	Age 12	Age 15	Age 12	Age 15
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Test score percentile gaps within lower Hindu castes									
Lower Caste (Base- OBC)									
SC Hindu	-0.053	-0.025	0.084	-0.051	-0.048	-0.051	-0.130	-0.044	-0.091
	(0.075)	(0.076)	(0.091)	(0.082)	(0.083)	(0.092)	(0.083)	(0.085)	(0.084)
ST Hindu	-0.099	-0.059	-0.078	0.020	-0.137	-0.098	-0.090	-0.047	-0.161
	(0.144)	(0.115)	(0.104)	(0.115)	(0.093)	(0.121)	(0.121)	(0.119)	(0.114)
Observations	1,348	1,382	1,385	1,373	1,384	1,345	1,331	1,348	1,323
SES controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel b: Effect of perceived discrimination on test score percentiles within lower Hindu castes									
Lower Caste (Base- OBC)									
SC Hindu	-0.045	-0.035	0.096	-0.047	-0.042	-0.052	-0.120	-0.056	-0.094
	(0.076)	(0.078)	(0.088)	(0.080)	(0.082)	(0.091)	(0.080)	(0.086)	(0.084)
ST Hindu	-0.111	-0.054	-0.047	0.034	-0.133	-0.080	-0.061	-0.049	-0.149
	(0.144)	(0.117)	(0.101)	(0.118)	(0.091)	(0.123)	(0.117)	(0.125)	(0.117)
Perceived social discrimination	0.020	-0.081	-0.206***	-0.082	-0.162***	-0.108*	-0.144***	-0.154**	-0.056
	(0.063)	(0.052)	(0.064)	(0.065)	(0.052)	(0.058)	(0.054)	(0.065)	(0.072)
Observations	1,337	1,369	1,372	1,361	1,371	1,332	1,320	1,336	1,312
SES controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.12: Parental investment within lower Hindu castes

Table 1.12a: Differences in parental investment across SCs, STs, and OBCs

	Expenditure on education				School Fees	
	Age 5	Age 8	Age 12	Age 15	Age 12	Age 15
	(1)	(2)	(3)	(4)	(5)	(6)
Lower Caste (Base- OBC)						
SC Hindu	-0.104*	-0.209***	-0.068	-0.063	-0.163***	-0.163***
	(0.059)	(0.057)	(0.089)	(0.058)	(0.056)	(0.049)
ST Hindu	-0.106	-0.171**	0.020	0.209	-0.019	-0.052
	(0.078)	(0.081)	(0.080)	(0.199)	(0.078)	(0.058)
Observations	1,082	1,370	1,299	1,263	1,329	1,178
SES controls	Yes	Yes	Yes	Yes	Yes	Yes

	Enrolment at school				Private School			
	Age 5	Age 8	Age 12	Age 15	Age 5	Age 8	Age 12	Age 15
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lower Caste (Base- OBC)								
SC Hindu	-0.033	0.053**	0.005	0.042	-0.124*	-0.073**	-0.129***	-0.175***
	(0.034)	(0.025)	(0.017)	(0.030)	(0.063)	(0.034)	(0.030)	(0.039)
ST Hindu	-0.021	-0.016	-0.005	-0.018	0.019	-0.094	-0.049	-0.104*
	(0.045)	(0.024)	(0.025)	(0.033)	(0.123)	(0.058)	(0.039)	(0.055)
Observations	1,404	1,404	1,397	1,381	313	1,302	1,329	1,179
SES controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects and SES. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.12b: Effect of discrimination on parental investment for lower caste Hindus

	Expenditure on education				School Fees	
	Age 5	Age 8	Age 12	Age 15	Age 12	Age 15
	(1)	(2)	(3)	(4)	(5)	(6)
Lower Caste (Base- OBC)						
SC Hindu	-0.106*	-0.217***	-0.068	-0.060	-0.166***	-0.160***
	(0.058)	(0.057)	(0.086)	(0.060)	(0.057)	(0.050)
ST Hindu	-0.102	-0.154*	0.034	0.211	-0.017	-0.051
	(0.077)	(0.081)	(0.082)	(0.205)	(0.083)	(0.057)
Perceived social discrimination	-0.136***	-0.088*	-0.189***	-0.079	-0.075	-0.078
	(0.050)	(0.051)	(0.058)	(0.049)	(0.059)	(0.051)
Observations	1,071	1,358	1,289	1,253	1,317	1,169
SES controls	Yes	Yes	Yes	Yes	Yes	Yes

	Enrolment at school				Private School			
	Age 5	Age 8	Age 12	Age 15	Age 5	Age 8	Age 12	Age 15
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lower Caste (Base- OBC)								
SC Hindu	-0.034	0.050**	0.008	0.040	-0.113**	-0.072**	-0.131***	-0.176***
	(0.034)	(0.025)	(0.017)	(0.029)	(0.056)	(0.035)	(0.030)	(0.039)
ST Hindu	-0.025	-0.027	0.006	-0.013	0.023	-0.091	-0.050	-0.100*
	(0.042)	(0.026)	(0.021)	(0.032)	(0.123)	(0.062)	(0.044)	(0.053)
Perceived social discrimination	-0.054*	0.006	-0.026	-0.055**	-0.120*	-0.061**	-0.018	-0.055*
	(0.029)	(0.018)	(0.017)	(0.024)	(0.061)	(0.025)	(0.027)	(0.030)
Observations	1,391	1,391	1,384	1,369	310	1,292	1,317	1,170
SES controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects and SES. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

All the regressions include socioeconomic controls, as well as location fixed effects. The estimates reduce in size, but overall the results mirror the findings from the main analysis.

1.6.2 Ordinality- Are the results simply an artefact of test score scaling?

As discussed in section 1.4.2, test scores are ordinal measures of achievement. In order to verify that the results are not mere artefacts of test score scaling, I use the solution proposed by Penney (2017) which employs the ordinary least squares variant of unconditional quantile regressions (UQR) to estimate the test score gap at the median and then normalizes the coefficients of interest by dividing them with the standard error of the regression. Its invariance to monotonic transformations means that the same regression results will be obtained as if one had access to the "true" set of test scores. Table 1.13 displays the coefficient estimates for lower caste Hindus from estimating equation (1) using OLS, unconditional quantile regression at the median, and the method outlined in Penney (2017).

Comparing the z-UQR estimates at the median in columns (2) and (5) with those from the proposed method in columns (3) and (6) titled 'Normalized', both without and with SES controls, respectively, the evolution pattern of percentile ranking gaps over time is almost identical. The results show that the gaps in percentile rankings between lower and upper-caste Hindus are constant over time suggesting that the gaps persist over time. The OLS results are also reported in the table in columns (1) and (4) for comparison purposes and they exhibit similar evolution patterns as the normalized estimates.

Overall, the above robustness check assuages the concerns of ordinality and test score scaling and raises confidence in the results.

1.6.3 Oster test

There are many unobserved individual or household characteristics, such as parents' preferences for children's education and children's innate ability, that may be correlated with caste or perceived social discrimination, and excluding them from the regression may lead to omitted variable bias. To check if the estimates of gaps in children's test scores and parental investment across castes and the effect of perceived discrimination are robust to omitted unobservable variable bias, I perform the Oster test (Oster, 2019).

Oster (2019) builds on Altonji et al. (2005), to develop a novel method for assessing bias from unobservable factors and estimating the degree of selection on unobservable that would be required to drive the ATT to 0 (called $\tilde{\delta}$). It exploits information on coefficient movements and movements in R-squared values after the inclusion of controls to compute bounds for the treatment effect.

To identify bias-adjusted β^*, one needs assumptions on (1) δ, the degree of selection on unobservables, and (2) $R_{\max}$ that indicates the maximum share of variance of the outcome that could be explained by any set of observable and unobservable covariates. Oster (2019) argues that $\delta \in [0, 1]$ is an appropriate bound because observed control variables are deliberately chosen as determinants of the outcome and must be at least as important as the unobservables. It is unlikely that $\delta > 1$ i.e. unobservables have a stronger impact on the outcome variable than the control variables.

So, for this analysis I assume $R^2_{max} = 1.3 \times R^2_{controlled}$, a rule proposed by Oster, where $R^2_{controlled}$ is the R^2 of the model with all observables and assume δ = 0.80. In other words, I am assuming that selection on unobservable is 80% of selection on observable and inclusion of these unobservables would have increased R^2 of the regression by 1.3 times. I also estimate the value of $\tilde{\delta}$ that will drive the estimate to 0.

I perform this test by estimating the following models

$$\boldsymbol{Y_{it} = \alpha_0 + \beta_t\, UpperCaste_i + \theta_t X_{it} + \gamma_i + \epsilon_{it}} \quad \textbf{(1.4)}$$

$$\boldsymbol{Y_{it} = \alpha_0 + \beta_t\, Caste_i + \rho_t Discr_i + \theta_t X_{it} + \gamma_i + \epsilon_{it}} \quad \textbf{(1.5)}$$

where Y_{it} denotes child i's percentile ranking in round t in various tests and parental investment in child i's education in round t. $UpperCaste_{it}$ is an indicator of caste which takes a value of 1, if the child belongs to the upper-caste and 0, otherwise. $Caste_{it}$ is a full set of caste dummies with upper Hindu caste as the base category and $Discr_{it}$ is the index for parents' perceived discrimination. X_{it} represents an array of child-level social and economic variables

The results are reported in Table 1.14. Baseline effects (column 1) are the estimates from the regressions including controls for child's sex, birth order, and location fixed effect (variables are assumed to be unrelated to the set of proportionally related unobservables). Controlled effects are the estimates from the regressions including the full control set. Bias adjusted β^* are the estimates adjusting for the plausible bias due to the unobservables.

Estimates reported in Table 1.14a capture the differences in test scores and parental investment between the upper Hindu caste and other social groups. Even when selection on unobservables is as high as 80% of selection on observables, the omitted variable bias does not change the direction of most of the estimates, except for PPVT tests in rounds 2 and 3. The last column reports the minimum degree of selection on unobservables that would be required to drive the estimate to 0 (called $\tilde{\delta}$). For most of the significant estimates, the estimated $\tilde{\delta}$ is close to 1.

In Table 1.14b, I report the estimates of the effect of parent's perceived discrimination on children's test scores and parental investment. All the estimates are robust to omitted variable bias, except for school enrolment in round 5 and the estimated $\tilde{\delta}$ is greater than 1 for all significant estimates raising our confidence in the results.

Table 1.13: Jeffrey Penney

Table 1.13a: Differences in test scores between lower and upper-caste Hindus

			PPVT			
	z-OLS	**z-UQR**	**Normalized**	**z-OLS**	**z-UQR**	**Normalized**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Round 2	-0.321***	-0.576***	-0.374***	-0.178***	-0.381***	-0.251***
	(0.066)	(0.119)	(0.069)	(0.061)	(0.099)	(0.063)
Round 3	-0.278***	-0.372**	-0.224***	-0.158*	-0.190	-0.116
	(0.086)	(0.146)	(0.085)	(0.084)	(0.151)	(0.089)
Round 4	-0.368***	-0.455***	-0.285***	-0.218***	-0.246*	-0.158**
	(0.070)	(0.129)	(0.078)	(0.066)	(0.126)	(0.078)
Round 5	-0.381***	-0.390***	-0.248***	-0.267***	-0.240*	-0.155**
	(0.086)	(0.123)	(0.076)	(0.084)	(0.125)	(0.078)
			Maths			
Round 3	-0.373***	-0.514***	-0.332***	-0.213***	-0.274***	-0.182***
	(0.057)	(0.100)	(0.063)	(0.053)	(0.097)	(0.062)
Round 4	-0.454***	-0.678***	-0.422***	-0.277***	-0.436***	-0.277***
	(0.073)	(0.124)	(0.075)	(0.076)	(0.131)	(0.081)
Round 5	-0.548***	-0.715***	-0.429***	-0.401***	-0.521***	-0.315***
	(0.093)	(0.162)	(0.095)	(0.093)	(0.166)	(0.098)
			English			
Round 4	-0.476***	-0.682***	-0.430***	-0.274***	-0.367***	-0.241***
	(0.084)	(0.134)	(0.082)	(0.079)	(0.134)	(0.086)
			Reading			
Round 5	-0.349***	-0.437***	-0.273***	-0.235***	-0.293**	-0.185**
	(0.079)	(0.117)	(0.071)	(0.077)	(0.121)	(0.074)
SES controls	No	No		Yes	Yes	

Table 1.13b: Effect of discrimination on test scores

	z-OLS	z-UQR	Normalized	z-OLS	z-UQR	Normalized
	(1)	(2)	(3)	(4)	(5)	(6)
			PPVT			
Round 2	0.002	0.125	0.081	0.029	0.164*	0.108*
	(0.055)	(0.086)	(0.055)	(0.055)	(0.090)	(0.058)
Round 3	-0.058	-0.055	-0.033	-0.035	-0.018	-0.011
	(0.046)	(0.084)	(0.049)	(0.044)	(0.081)	(0.048)
Round 4	-0.193***	-0.294***	-0.186***	-0.178***	-0.266***	-0.173***
	(0.060)	(0.097)	(0.060)	(0.058)	(0.097)	(0.061)
Round 5	-0.112*	-0.119	-0.076	-0.094	-0.099	-0.064
	(0.062)	(0.092)	(0.057)	(0.062)	(0.090)	(0.057)
			Maths			
Round 3	-0.141***	-0.262***	-0.170***	-0.105**	-0.211***	-0.140***
	(0.049)	(0.079)	(0.050)	(0.047)	(0.080)	(0.051)
Round 4	-0.118*	-0.105	-0.065	-0.078	-0.039	-0.024
	(0.065)	(0.104)	(0.062)	(0.059)	(0.096)	(0.059)
Round 5	-0.149**	-0.182**	-0.110**	-0.126**	-0.168**	-0.103**
	(0.057)	(0.082)	(0.048)	(0.054)	(0.078)	(0.046)
			English R4			
Round 4	-0.186***	-0.231**	-0.146**	-0.145**	-0.168*	-0.111*
	(0.061)	(0.092)	(0.057)	(0.056)	(0.089)	(0.057)
			Reading R5			
Round 5	-0.087	-0.098	-0.061	-0.068	-0.077	-0.048
	(0.066)	(0.104)	(0.063)	(0.065)	(0.105)	(0.064)
SES controls	No	No		Yes	Yes	

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

1.6.4 Multiple hypothesis testing

Since this paper looks at multiple outcomes, this raises concerns about the over-rejection of null hypotheses unless the multiplicity of the testing framework is explicitly considered (Anderson, 2008; Conti et al., 2016).[17] To address this issue, I adjust for multiple hypotheses testing using the Romano & Wolf (2005) stepdown method.[18] The Romano-Wolf correction uses bootstrap to control for the

[17] Suppose that a single-hypothesis test statistic rejects a true null hypothesis at significance level α. Thus, the probability of rejecting a single hypothesis out of K true hypotheses is given by $1 - (1 - \alpha)$ K. As the number of outcomes K increases, the likelihood of rejecting a true null hypothesis departs from α (Conti et al., 2016).

[18] Lehmann and Romano (2005) and Romano and Wolf (2005) discuss the stepdown procedure in depth.

familywise error rate (FWER) which captures the probability of rejecting at least one true null hypothesis in a family of hypotheses under test. As discussed in Conti et al. (2016) and Heckman et al. (2010), I define two blocks of similar outcomes- test scores and parental investment and carry out 1000 bootstrap replications.

The estimates are reported in Table 1.15. Panel A reports the estimates for cognitive outcomes and Panel B reports the estimates for parental investment. Columns 1 and 3 report the p-values for estimates on gaps between lower and upper Hindu castes from specification 1.1 and estimates on discrimination from specification 1.2, respectively. Columns 2 and 4 report the p-values adjusted for multiple hypothesis testing associated with columns 1 and 3, respectively. The estimates on lower Hindu caste and discrimination are robust to multiple hypothesis testing as the Romano-Wolf adjusted p-values are always similar to the model p-values.

1.7 Discussion

The objective of this paper was twofold. Firstly, to investigate at what age the gaps in human capital formation across social groups originate and how they evolve as children age from 5 to 15 years. And secondly, to analyse how perceived social discrimination affects human capital formation over this time. I look at two determinants of human capital- cognitive outcome, as measured by the performance at various tests and parental investment in children's human capital. This is the first study to analyse the dynamics of the Indian caste system as well as perceived social discrimination in human capital formation over time. This paper speaks to the following two strands of literature (1) the literature of human capital formation and (2) the strand of work in economics, which focuses on the role of social institutions, social discrimination, and stereotypes.

The findings of this paper suggest that there are substantial and persistent gaps in the test scores of children across social groups which cannot be completely explained by differences in SES. Lower caste Hindus and Muslims score significantly less in PPVT, maths, English, and reading tests relative to upper-caste Hindus. Gaps between lower caste Hindus and upper-caste Hindus in PPVT percentile rankings are constant over time. Whereas, there is evidence of a slight increase in percentile ranking gap in maths tests over time. Muslims, on the other hand, perform equally well as upper-caste Hindus at the age of 5 and 8 years in the PPVT test, but over time lose significant ground to both

Table 1.14: Oster test

Table 1.14a: Effect of caste

	Treatment variable- Lower Hindu castes; Rmax=1.3 ˜ R; delta=0.8			
Dependent variable	**Baseline effect (std dev), [R2]**	**Controlled effect (std dev), [R2]**	**Bias adjusted β**	**$\tilde{\delta}$ for β=0 given R_{max}**
		Test Scores		
z-score PPVT pctile-R2	0.264*** (0.065) [0.266]	0.156** (0.061) [0.300]	-0.049	0.61
z-score PPVT pctile-R3	0.223*** (0.082) [0.263]	0.142* (0.080) [0.283]	-0.137	0.41
z-score PPVT pctile-R4	0.352*** (0.063) [0.257]	0.236*** (0.059) [0.291]	0.034	0.92
z-score PPVT pctile-R5	0.357*** (0.079) [0.203]	0.283*** (0.080) [0.223]	0.069	1.03
z-score Maths pctile-R3	0.344*** (0.056) [0.301]	0.273*** (0.057) [0.289]	0.004	0.78
z-score Maths pctile-R4	0.414*** (0.062) [0.241]	0.277*** (0.066) [0.291]	0.105	1.26
z-score Maths pctile-R5	0.454*** (0.085) [0.225]	0.355*** (0.087) [0.261]	0.167	1.43
z-score English pctile-R4	0.445*** (0.078) [0.265]	0.281*** (0.073) [0.340]	0.113	1.31
z-score Reading pctile-R5	0.352*** (0.072) [0.190]	0.256*** (0.071) [0.216]	0.088	1.18
		Parental Investment		
z-Investment R2	0.517*** (0.093) [0.293]	0.360*** (0.098) [0.341]	0.098	1.07
z-Investment R3	0.591*** (0.107) [0.209]	0.463*** (0.100) [0.261]	0.312	2.14
z-Investment R4	0.406*** (0.116) [0.229]	0.305*** (0.110) [0.263]	0.124	1.30
z-Investment R5	0.404*** (0.083) [0.186]	0.311*** (0.083) [0.221]	0.163	1.58
z-School Fees R4	0.512*** (0.104) [0.234]	0.395*** (0.106) [0.274]	0.216	1.64
z-School Fees R5	0.488*** (0.088) [0.257]	0.390*** (0.085) [0.290]	0.187	1.44
School Enrolment R2	-0.005 (0.033) [0.124]	-0.005 (0.035) [0.129]	0.008	0.34
School Enrolment R3	0.007 (0.017) [0.104]	0.008 (0.016) [0.106]	-0.050	0.14
School Enrolment R4	0.022* (0.012) [0.093]	0.016 (0.013) [0.095]	-0.027	0.30
School Enrolment R5	0.081*** (0.021) [0.133]	0.063*** (0.023) [0.143]	-0.002	0.78
Private School R2	0.284*** (0.090) [0.544]	0.058(0.051) [0.106]	0.016	1.02
Private School R3	0.251*** (0.045) [0.384]	0.183*** (0.048) [0.320]	0.054	1.11
Private School R4	0.266*** (0.042) [0.306]	0.225*** (0.041) [0.317]	0.127	1.68
Private School R5	0.246*** (0.040) [0.262]	0.269*** (0.053) [0.275]	0.155	1.73

Table 1.14b: Effect of discrimination

Treatment variable- Discrimination; Rmax=1.3*R; delta=0.8				
Dependent variable	**Baseline effect (std dev), [R2]**	**Controlled effect (std dev), [R2]**	**Bias adjusted β**	$\tilde{\delta}$ **for** β **=0 given** R_{max}
		Test Scores		
z-score PPVT pctile-R2	0.009 (0.055) [0.262]	0.029 (0.055) [0.303]	0.094	-0.36
z-score PPVT pctile-R3	-0.078* (0.045) [0.261]	-0.045 (0.043) [0.286]	0.047	0.40
z-score PPVT pctile-R4	-0.211*** (0.061) [0.255]	-0.178*** (0.059) [0.303]	-0.012	2.21
z-score PPVT pctile-R5	-0.136*** (0.060) [0.193]	-0.098 (0.061) [0.225]	-0.025	1.07
z-score Maths pctile-R3	-0.161*** (0.047) [0.293]	-0.112** (0.047) [0.346]	-0.036	1.17
z-score Maths pctile-R4	-0.155** (0.062) [0.228]	-0.091 (0.058) [0.293]	-0.026	1.12
z-score Maths pctile-R5	-0.195*** (0.054) [0.212]	-0.145*** (0.051) [0.264]	-0.071	1.52
z-score English pctile-R4	-0.222*** (0.058) [0.257]	-0.153*** (0.054) [0.295]	-0.084	1.74
z-score Reading pctile-R5	-0.107 (0.065) [0.177]	-0.069 (0.063) [0.213]	-0.010	0.93
		Parental Investment		
z-Investment R2	-0.212*** (0.060) [0.281]	-0.161*** (0.053) [0.351]	-0.093	1.86
z-Investment R3	-0.127** (0.054) [0.181]	-0.052 (0.052) [0.267]	0.003	0.75
z-Investment R4	-0.289*** (0.053) [0.217]	-0.233*** (0.051) [0.263]	-0.159	2.33
z-Investment R5	-0.141*** (0.039) [0.169]	-0.092** (0.038) [0.222]	-0.044	1.52
z-School Fees R4	-0.175*** (0.048) [0.207]	-0.105** (0.045) [0.268]	-0.038	1.24
z-School Fees R5	-0.151*** (0.050) [0.221]	-0.095** (0.047) [0.283]	-0.038	1.33
School Enrolment R2	-0.032 (0.024) [0.125]	-0.033 (0.024) [0.130]	-0.054	-1.47
School Enrolment R3	0.013 (0.013) [0.103]	-0.014 (0.014) [0.106]	0.018	-4.12
School Enrolment R4	-0.020 (0.013) [0.096]	-0.016 (0.014) [0.098]	0.000	0.80
School Enrolment R5	-0.054*** (0.020) [0.131]	-0.045** (0.020) [0.147]	-0.024	1.61
Private School R2	-0.153*** (0.053) [0.521]	-0.150*** (0.055) [0.602]	-0.136	3.90
Private School R3	-0.108** (0.023) [0.369]	-0.068*** (0.023) [0.448]	-0.015	1.03
Private School R4	-0.088*** (0.025) [0.283]	-0.048* (0.026) [0.357]	-0.007	0.94
Private School R5	-0.102*** (0.027) [0.248]	-0.072*** (0.027) [0.310]	-0.034	1.51

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table 1.15: Multiple hypothesis testing

Treatment Variable-	Lower Hindu Caste		Discrimination	
	Model p-value	Romano-Wolf p-value	Model p-value	Romano-Wolf p-value
Outcome Variables	(1)	(2)	(3)	(4)
		Panel A: Cognitive Outcomes		
z-score PPVT pctile-R2	0.005	0.002	0.597	0.445
z-score PPVT pctile-R3	0.088	0.007	0.297	0.327
z-score PPVT pctile-R4	0.001	0.001	0.003	0.001
z-score PPVT pctile-R5	0.001	0.001	0.111	0.099
z-score Maths pctile-R3	0.0004	0.001	0.018	0.004
z-score Maths pctile-R4	0.0004	0.001	0.117	0.099
z-score Maths pctile-R5	0.0002	0.001	0.006	0.001
z-score English pctile-R4	0.0005	0.001	0.006	0.001
z-score Reading pctile-R5	0.0014	0.001	0.278	0.327
		Panel B: Parental investment		
z-Investment R2	0.001	0.002	0.003	0.001
z-Investment R3	0.000	0.001	0.317	0.290
z-Investment R4	0.008	0.003	0.000	0.001
z-Investment R5	0.001	0.001	0.017	0.003
z-School Fees R4	0.001	0.001	0.021	0.007
z-School Fees R5	0.000	0.001	0.044	0.024
School Enrolment R2	0.794	0.696	0.171	0.171
School Enrolment R3	0.589	0.689	0.332	0.290
School Enrolment R4	0.164	0.126	0.254	0.251
School Enrolment R5	0.012	0.003	0.024	0.008
Private School R2	0.361	0.388	0.035	0.013
Private School R3	0.001	0.001	0.125	0.130
Private School R4	0.000	0.001	0.058	0.028
Private School R5	0.000	0.001	0.003	0.001

*Notes- Columns 1 and 3 report the p-values for estimates on lower Hindu castes from specification 1.1 and discrimination from specification 1.2, respectively. Columns 2 and 4 report the p-values adjusted for multiple hypothesis testing associated with columns 1 and 3, respectively, using 1000 bootstrap replications. Standard errors are adjusted for clustering at the community level. All regressions include SES controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

upper and lower caste Hindus. However, in maths, English, and reading tests, Muslims persistently lag behind Hindus.

This paper also establishes that parents belonging to backward social groups invest significantly less in the education of children. These castes and religion-based gaps in parental investments are also persistent over time. Children belonging to backward social groups are more likely to drop out early as compared to children from upper Hindu castes and they are also less likely to attend private school. These gaps persist even after differences in the socioeconomic background are accounted for.

Consistent with the hypothesis that children develop an awareness of discrimination as they grow old which negatively affects their cognitive development, this paper finds that perception of discrimination by parents negatively affects children's performance at a later age. Perception of social discrimination by parents demotivates investment in children's education throughout childhood. It also increases early drop-outs from schools and reduces the likelihood of attending private schools. The effect of perceived social discrimination on children's cognitive development as well as parental investment is found significant only for backward castes, suggesting that backward castes are more vulnerable.

The findings of this paper are informative for enduring debates in India about social policies favouring children belonging to disadvantaged social groups in early age. The results point out that the social group in which children are born as well as the perceptions about social discrimination against oneself may shape their abilities, and thus, affect their life outcomes such as cognitive development, educational attainment, etc. Policies promoting investment in the education of children belonging to backward castes at early ages and rooting out social discrimination against them are fundamental to improving human capital. Ensuring the social inclusiveness of backward castes, sensitizing teachers and the youth, and convincing parents of first-generation students of the value of education can make a big difference.

The Government of India has introduced policies of affirmative action to address social inequality, such as reservations at government universities, government jobs, and legislative representation to backward groups. Literature has highlighted the success of these policies, including improved representation of marginalized communities in government jobs (Deshpande & Ramachandran, 2016) and improved diversity of social backgrounds in higher education (Bertrand et al., 2010). However, these affirmative action policies may be insufficient to respond to the gaps in human capital generated early in life. They may not raise human capital among children from backward castes but only provide them representations at higher educations and jobs by reserving seats for them and diluting the eligibility criterion.

The Government of India also provides free education to socially and economically disadvantaged children through public schools, however, there is wide evidence in the literature that these schools are poor in quality, both in terms of infrastructure and quality of education. In 2009, the Right of Children to Free and Compulsory Education Act or Right to Education Act (RTE) was enacted, which makes education a fundamental right of every child between the ages of 6 and 14. It requires all private schools to reserve 25% of seats for the poor and other categories of children. However, the act has been criticized for several reasons. In India, elementary education starts at the age of 2 and half years of age and this policy excludes children below the age of 6 years. Moreover, according to the findings of this paper, significant differences in cognitive outcomes and parental investment develop across castes by the age of 5 years and thus, this act does not address the issue of significant gaps generated before the age of 6. Similarly, the RTE act excludes children aged above 14 years. In India, secondary education covers children aged 14 to 18, and exclusion of children above 14 years would lead to a significant increase in school drop-out at this age, which is also one of the findings of this paper.

The paper points towards the need for policies that alleviate the consequences of being born in a particular caste which is a major source of inequality in India.

1.8 Appendix

Table A1.1: Analysis on the sub-sample of children who did not migrate over time

Panel A: Gaps in test scores across castes

	Standardized PPVT percentiles							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.389***	-0.229***	-0.298***	-0.171**	-0.387***	-0.199**	-0.403***	-0.273***
	(0.062)	(0.057)	(0.084)	(0.084)	(0.086)	(0.079)	(0.087)	(0.087)
Muslim	-0.243**	-0.048	-0.350*	-0.237	-0.756***	-0.581***	-0.505***	-0.349**
	(0.121)	(0.114)	(0.178)	(0.166)	(0.155)	(0.161)	(0.168)	(0.169)
Other religion	-0.195*	-0.063	-0.179	-0.065	-0.278**	-0.097	-0.442***	-0.313**
	(0.115)	(0.112)	(0.127)	(0.118)	(0.135)	(0.124)	(0.124)	(0.120)
Observations	1,479	1,464	1,531	1,514	1,548	1,531	1,543	1,526
SES controls	No	Yes	No	Yes	No	Yes	No	Yes

Standardized Percentiles	**Maths**						**English**		**Reading**	
	Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Caste (Base- Upper Hindu)										
SC/ST/BC Hindu	-0.413***	-0.231***	-0.441***	-0.245***	-0.496***	-0.336***	-0.491***	-0.270***	-0.382***	-0.244***
	(0.066)	(0.065)	(0.075)	(0.075)	(0.084)	(0.082)	(0.080)	(0.070)	(0.079)	(0.077)
Muslim	-0.595***	-0.406***	-0.705***	-0.497***	-0.667***	-0.513***	-0.628***	-0.392***	-0.670***	-0.529***
	(0.118)	(0.113)	(0.115)	(0.114)	(0.147)	(0.133)	(0.144)	(0.127)	(0.134)	(0.127)
Other religion	-0.356**	-0.204*	-0.346***	-0.176	-0.410***	-0.263**	-0.371***	-0.185	-0.401***	-0.290**
	(0.137)	(0.117)	(0.128)	(0.108)	(0.127)	(0.118)	(0.123)	(0.111)	(0.123)	(0.117)
Observations	1,536	1,519	1,510	1,493	1,503	1,486	1,514	1,497	1,498	1,482
SES controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Panel B: Gaps in parental investment across castes

	Expenditure on Education							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.387***	-0.211*	-0.561***	-0.409***	-0.307**	-0.187	-0.348***	-0.262***
	(0.103)	(0.108)	(0.124)	(0.114)	(0.122)	(0.122)	(0.093)	(0.096)
Muslim	-0.592***	-0.467***	-0.720***	-0.592***	-0.338*	-0.248	-0.521***	-0.455***
	(0.149)	(0.133)	(0.149)	(0.132)	(0.182)	(0.169)	(0.143)	(0.137)
Other religion	-0.380***	-0.193	-0.564***	-0.407***	-0.183	-0.052	-0.325***	-0.218*
	(0.128)	(0.127)	(0.129)	(0.120)	(0.237)	(0.236)	(0.110)	(0.116)
Observations	1,202	1,185	1,531	1,513	1,460	1,442	1,449	1,431
SES controls	No	Yes	No	Yes	No	Yes	No	Yes

	School Fees				Enrolment at school							
	Age 12 (Round 4)		Age 15 (Round 5)		Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Caste (Base- Upper Hindu)												
SC/ST/BC Hindu	-0.407***	-0.246*	-0.412***	-0.306***	0.022	0.024	0.002	-0.007	-0.023	-0.017	-0.095***	-0.069**
	(0.135)	(0.135)	(0.099)	(0.098)	(0.037)	(0.038)	(0.018)	(0.019)	(0.016)	(0.017)	(0.028)	(0.029)
Muslim	-0.537***	-0.402***	-0.235	-0.158	0.002	-0.002	-0.009	-0.022	-0.005	0.002	-0.132**	-0.111**
	(0.150)	(0.142)	(0.277)	(0.280)	(0.055)	(0.053)	(0.025)	(0.031)	(0.024)	(0.025)	(0.051)	(0.051)
Other religion	-0.549***	-0.378***	-0.386***	-0.270***	-0.024	-0.032	0.029	0.017	-0.008	-0.002	-0.031	-0.009
	(0.116)	(0.114)	(0.102)	(0.103)	(0.056)	(0.059)	(0.025)	(0.024)	(0.016)	(0.017)	(0.034)	(0.035)
Observations	1,496	1,478	1,360	1,345	1,559	1,541	1,559	1,541	1,559	1,541	1,553	1,535
SES controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

	Type of School (Private School)							
	Age 5 (Round 2)		Age 8 (Round 3)		Age 12 (Round 4)		Age 15 (Round 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caste (Base- Upper Hindu)								
SC/ST/BC Hindu	-0.270***	-0.233***	-0.269***	-0.180***	-0.253***	-0.183***	-0.279***	-0.209***
	(0.087)	(0.080)	(0.054)	(0.048)	(0.050)	(0.046)	(0.045)	(0.041)
Muslim	-0.414**	-0.414**	-0.298***	-0.220***	-0.336***	-0.277***	-0.260***	-0.222**
	(0.188)	(0.198)	(0.072)	(0.068)	(0.067)	(0.059)	(0.084)	(0.089)
Other religion	-0.357***	-0.315***	-0.274***	-0.182***	-0.280***	-0.200***	-0.257***	-0.184***
	(0.095)	(0.086)	(0.079)	(0.067)	(0.065)	(0.053)	(0.063)	(0.059)
Constant	1.270***	1.249***	1.490***	1.508***	1.360***	1.336***	1.404***	1.320***
	(0.087)	(0.130)	(0.056)	(0.066)	(0.051)	(0.061)	(0.045)	(0.073)
Observations	344	338	1,465	1,448	1,496	1,478	1,361	1,346
R-squared	0.637	0.655	0.428	0.500	0.349	0.407	0.317	0.366
SES controls	No	Yes	No	Yes	No	Yes	No	Yes

*Notes- Standard errors are adjusted for clustering at the community level. All regressions control for location fixed effects. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table A1.2: Robustness Check- Controlling for baseline PPVT test score

Panel A: Differences in test scores across social groups- controlling for baseline PPVT test scores

	PPVT				Maths		
VARIABLES	PPVT R2	PPVT R3	PPVT R4	PPVT R5	Maths R3	Maths R4	Maths R5
Base- Upper Hindu							
SC/ST/BC Hindu	-0.178***	-0.117	-0.174***	-0.231***	-0.167***	-0.236***	-0.361***
	(0.061)	(0.080)	(0.066)	(0.088)	(0.050)	(0.073)	(0.091)
Muslim	-0.018	-0.258	-0.577***	-0.402**	-0.438***	-0.476***	-0.464***
	(0.129)	(0.168)	(0.156)	(0.184)	(0.095)	(0.115)	(0.106)
Other religion	-0.058	-0.041	-0.102	-0.329***	-0.196*	-0.156*	-0.276**
	(0.111)	(0.123)	(0.106)	(0.119)	(0.103)	(0.090)	(0.113)
Observations	1,832	1,796	1,797	1,783	1,883	1,828	1,805
R-squared	0.301	0.320	0.333	0.247	0.395	0.394	0.399

Panel B: Effect of discrimination on test scores- controlling for baseline PPVT test scores

	PPVT				Maths		
	PPVT R2	PPVT R3	PPVT R4	PPVT R5	Maths R3	Maths R4	Maths R5
Perceived social discrimination	0.029	-0.040	-0.185***	-0.100	-0.112**	-0.086	-0.127**
	(0.055)	(0.041)	(0.056)	(0.062)	(0.046)	(0.057)	(0.052)
Base- Upper Hindu							
SC/ST/BC Hindu	-0.170***	-0.111	-0.181***	-0.229**	-0.160***	-0.226***	-0.359***
	(0.062)	(0.082)	(0.066)	(0.089)	(0.051)	(0.075)	(0.092)
Muslim	-0.012	-0.244	-0.590***	-0.406**	-0.425***	-0.466***	-0.463***
	(0.122)	(0.164)	(0.154)	(0.186)	(0.095)	(0.115)	(0.105)
Other religion	-0.053	-0.035	-0.097	-0.322***	-0.180*	-0.142	-0.272**
	(0.110)	(0.124)	(0.107)	(0.122)	(0.101)	(0.091)	(0.117)
Observations	1,815	1,780	1,781	1,768	1,784	1,741	1,725
R-squared	0.303	0.322	0.343	0.248	0.394	0.333	0.299

Panel C: Differential effect of discrimination on test scores across social groups- controlling for baseline PPVT test scores

	PPVT				Maths		
VARIABLES	PPVT R2	PPVT R3	PPVT R4	PPVT R5	Maths R3	Maths R4	Maths R5
Base- Upper Hindus × No Discr							
Lower Hindu × No Discr	-0.181***	-0.055	-0.126*	-0.244***	-0.045	-0.186**	-0.354***
	(0.069)	(0.091)	(0.074)	(0.086)	(0.057)	(0.082)	(0.095)
Muslim × No Discr	-0.080	-0.234	-0.501***	-0.389*	-0.366***	-0.429***	-0.418***
	(0.128)	(0.164)	(0.180)	(0.213)	(0.116)	(0.123)	(0.108)
Other religion × No Discr	-0.048	0.006	-0.081	-0.337**	-0.047	-0.161	-0.306***
	(0.125)	(0.139)	(0.131)	(0.150)	(0.103)	(0.117)	(0.113)
Upper Hindu × Discr	-0.034	0.164	0.038	-0.149	0.323**	0.060	-0.100
	(0.161)	(0.125)	(0.119)	(0.166)	(0.133)	(0.127)	(0.181)
Lower Hindu × Discr	-0.159*	-0.134	-0.334***	-0.330***	-0.218***	-0.301***	-0.481***
	(0.086)	(0.093)	(0.096)	(0.090)	(0.067)	(0.092)	(0.098)
Muslim × Discr	0.155	-0.165	-0.847***	-0.583**	-0.382**	-0.546***	-0.686***
	(0.153)	(0.263)	(0.198)	(0.242)	(0.147)	(0.160)	(0.167)
Other religion × Discr	-0.073	-0.024	-0.169	-0.425***	-0.266	-0.086	-0.313
	(0.183)	(0.166)	(0.158)	(0.143)	(0.191)	(0.174)	(0.204)
Observations	1,815	1,780	1,781	1,768	1,784	1,741	1,725
R-squared	0.304	0.323	0.345	0.248	0.399	0.334	0.300

*Notes: Regressions for rounds 3, 4, and 5 control for PPVT scores obtained at age 2 (round 2). All regressions include socioeconomic controls and location fixed effects. Standard errors are adjusted for clustering at the community level. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table A1.3: Robustness Check- Controlling for baseline PPVT test scores

Panel A: Differences in parental investment across social groups- controlling for baseline PPVT test scores

	Expenditure on education				**School fees**		**Enrolment at school**			
	EXP R2	EXP R3	EXP R4	EXP R5	FEES R4	FEES R5	ENROL R2	ENROL R3	ENROL R4	ENROL R5
Base- Upper Hindu										
SC/ST/BC Hindu	-0.347***	-0.396***	-0.288**	-0.288***	-0.375***	-0.391***	0.009	-0.001	-0.015	-0.060**
	(0.103)	(0.096)	(0.120)	(0.090)	(0.118)	(0.091)	(0.036)	(0.016)	(0.013)	(0.026)
Muslim	-0.542***	-0.578***	-0.411***	-0.502***	-0.539***	-0.353**	-0.016	-0.027	0.005	-0.099**
	(0.090)	(0.132)	(0.127)	(0.085)	(0.124)	(0.140)	(0.053)	(0.028)	(0.017)	(0.038)
Other religion	-0.262*	-0.466***	-0.215	-0.257**	-0.489***	-0.403***	-0.029	0.027	-0.004	-0.005
	(0.155)	(0.100)	(0.219)	(0.119)	(0.118)	(0.102)	(0.057)	(0.023)	(0.017)	(0.035)
Observations	1,463	1,781	1,682	1,656	1,754	1,586	1,908	1,815	1,804	1,788
R-squared	0.343	0.265	0.272	0.233	0.285	0.307	0.129	0.109	0.104	0.157

	Private school			
	R2	R3	R4	R5
Base- Upper Hindu				
SC/ST/BC Hindu	-0.222**	-0.167***	-0.225***	-0.203***
	(0.088)	(0.043)	(0.039)	(0.041)
Muslim	-0.321**	-0.189***	-0.279***	-0.178**
	(0.161)	(0.055)	(0.044)	(0.076)
Other religion	-0.326***	-0.167***	-0.251***	-0.185***
	(0.087)	(0.063)	(0.053)	(0.057)
Observations	416	1,704	1,736	1,565
R-squared	0.575	0.452	0.366	0.314

Panel B: Effect of discrimination on parental investment- controlling for baseline PPVT test scores

	Expenditure on education				School fees		Enrolment at school			
	EXP R2	EXP R3	EXP R4	EXP R5	FEES R4	FEES R5	ENROL R2	ENROL R3	ENROL R4	ENROL R5
Perceived social discrimination	-0.161***	-0.068	-0.256***	-0.086**	-0.106**	-0.088*	-0.033	0.015	-0.013	-0.044**
	(0.053)	(0.054)	(0.056)	(0.038)	(0.046)	(0.046)	(0.024)	(0.014)	(0.013)	(0.019)
Base- Upper Hindu										
SC/ST/BC Hindu	-0.350***	-0.397***	-0.279**	-0.227**	-0.337***	-0.320***	0.015	0.000	-0.014	-0.056**
	(0.105)	(0.097)	(0.120)	(0.087)	(0.119)	(0.100)	(0.036)	(0.016)	(0.013)	(0.026)
Muslim	-0.550***	-0.585***	-0.404***	-0.422***	-0.501***	-0.258	-0.009	-0.027	0.005	-0.096**
	(0.093)	(0.135)	(0.130)	(0.109)	(0.120)	(0.226)	(0.056)	(0.028)	(0.017)	(0.038)
Other religion	-0.263*	-0.465***	-0.195	-0.201*	-0.456***	-0.337***	-0.018	0.027	-0.002	0.002
	(0.157)	(0.100)	(0.219)	(0.119)	(0.119)	(0.114)	(0.057)	(0.023)	(0.017)	(0.036)
Observations	1,447	1,766	1,669	1,643	1,738	1,573	1,888	1,799	1,788	1,773
R-squared	0.351	0.270	0.273	0.230	0.278	0.301	0.130	0.107	0.108	0.160

	Private school			
	R2	R3	R4	R5
Perceived social discrimination	-0.150***	-0.082***	-0.045	-0.069**
	(0.055)	(0.023)	(0.028)	(0.027)
Base- Upper Hindu				
SC/ST/BC Hindu	-0.247***	-0.157***	-0.220***	-0.198***
	(0.090)	(0.042)	(0.040)	(0.042)
Muslim	-0.282*	-0.181***	-0.279***	-0.176**
	(0.169)	(0.055)	(0.044)	(0.073)
Other religion	-0.343***	-0.152**	-0.247***	-0.178***
	(0.088)	(0.064)	(0.053)	(0.057)
Observations	411	1,690	1,720	1,552
R-squared	0.602	0.458	0.367	0.317

Panel C: Differential effect of discrimination on parental investment across social groups- controlling for baseline PPVT test scores

	Expenditure on education				School fees		Enrolment at school			
	EXP R2	EXP R3	EXP R4	EXP R5	FEES R4	FEES R5	ENROL R2	ENROL R3	ENROL R4	ENROL R5
Base- Upper Hindus × No Discr										
Lower Hindu × No Discr	-0.365**	-0.387***	-0.314**	-0.230**	-0.326***	-0.309***	0.031	0.007	-0.002	-0.040
	(0.148)	(0.105)	(0.139)	(0.104)	(0.123)	(0.116)	(0.038)	(0.020)	(0.015)	(0.026)
Muslim × No Discr	-0.586***	-0.621***	-0.424***	-0.454***	-0.423***	-0.236	-0.055	-0.043	0.013	-0.059
	(0.129)	(0.157)	(0.150)	(0.122)	(0.127)	(0.273)	(0.043)	(0.033)	(0.013)	(0.038)
Other religion × No Discr	-0.225	-0.447***	-0.212	-0.137	-0.447***	-0.331**	0.012	0.020	0.002	-0.011
	(0.219)	(0.122)	(0.287)	(0.154)	(0.129)	(0.133)	(0.065)	(0.029)	(0.021)	(0.048)
Upper Hindu × Discr	-0.209	-0.043	-0.388***	-0.091	-0.034	-0.039	0.009	0.029	0.032*	0.020
	(0.245)	(0.246)	(0.138)	(0.124)	(0.193)	(0.196)	(0.055)	(0.023)	(0.017)	(0.031)
Lower Hindu × Discr	-0.515***	-0.469***	-0.547***	-0.311***	-0.421***	-0.401***	-0.022	0.011	-0.023	-0.091***
	(0.146)	(0.126)	(0.128)	(0.096)	(0.131)	(0.118)	(0.042)	(0.021)	(0.018)	(0.031)
Muslim × Discr	-0.656***	-0.543***	-0.698***	-0.423***	-0.762***	-0.376**	0.111	0.044*	0.003	-0.189**
	(0.205)	(0.151)	(0.143)	(0.152)	(0.139)	(0.163)	(0.119)	(0.026)	(0.039)	(0.074)
Other religion × Discr	-0.567***	-0.549***	-0.504***	-0.414***	-0.534***	-0.405***	-0.079	0.063***	0.006	0.023
	(0.148)	(0.138)	(0.180)	(0.118)	(0.147)	(0.145)	(0.073)	(0.023)	(0.031)	(0.046)
Observations	1,447	1,766	1,669	1,643	1,738	1,573	1,888	1,799	1,788	1,773
R-squared	0.352	0.271	0.273	0.230	0.279	0.302	0.134	0.108	0.110	0.163

	Private school			
VARIABLES	R2	R3	R4	R5
Base- Upper Hindus × No Discr				
Lower Hindu × No Discr	-0.278***	-0.159***	-0.243***	-0.202***
	(0.101)	(0.040)	(0.042)	(0.045)
Muslim × No Discr	-0.277	-0.188***	-0.251***	-0.179**
	(0.235)	(0.051)	(0.044)	(0.080)
Other religion × No Discr	-0.355***	-0.150**	-0.259***	-0.155**
	(0.105)	(0.073)	(0.064)	(0.064)
Upper Hindu × Discr	-0.257*	-0.090	-0.113	-0.077
	(0.141)	(0.070)	(0.084)	(0.083)
Lower Hindu × Discr	-0.393***	-0.240***	-0.263***	-0.265***
	(0.119)	(0.045)	(0.046)	(0.046)
Muslim × Discr	-0.480***	-0.252**	-0.450***	-0.242**
	(0.160)	(0.101)	(0.106)	(0.103)
Other religion × Discr	-0.546***	-0.243***	-0.310***	-0.297***
	(0.101)	(0.087)	(0.070)	(0.073)
Observations	411	1,690	1,720	1,552
R-squared	0.605	0.458	0.369	0.318

Notes: Regressions for rounds 3, 4, and 5 control for PPVT scores obtained in round 2. All regressions include socioeconomic controls and location fixed effects. Standard errors are adjusted for clustering at the community level. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.

A 1.4: Index of parents' perceived discrimination

I construct an index for parents' perceived social discrimination using two survey questions asked to parents in round 2. Parents were asked to rate how much they agreed with the following two statements on a four-point Likert scale (from strongly agree to strongly disagree): 'When I am at shops/market I am usually treated with fairness and with respect by others'; and 'Other people in my street/village look down on me and my family'. The descriptive statistics of the two survey questions are provided below.

A. RESPECT: When I am at shops/market I am usually treated by others with fairness and with respect.

RESPECT CASTE	strongly agree	agree	disagree	strongly disagree	Total
SC/ST/BC Hindu	1,064	301	29	26	1,420
	0.749	0.212	0.020	0.018	
Other Hindu	226	35	3	6	270
	0.837	0.130	0.011	0.022	
Muslim	106	26	2	1	135
	0.785	0.193	0.015	0.007	
Other religion	81	19	3	3	106
	0.764	0.179	0.028	0.028	
Total	1,438	367	35	34	1,874
	0.767	0.196	0.019	0.018	

Almost 76 percent of the respondents strongly agree to be treated with respect. For upper-caste Hindus, this share is 84 percent. I create a binary variable "*Respect*" which takes a value of 1 if parents strongly agree to feel respected and 0 otherwise. The descriptive statistics are reported in the table below.

RESPECT CASTE	0	1	Total
SC/ST/BC Hindu	356	1,064	1,420

	0.251	0.749	
Other Hindu	44	226	270
	0.163	0.837	
Muslim	29	106	135
	0.215	0.785	
Other religion	25	81	106
	0.236	0.764	
Total	454	1,477	1,931

Table A1.4a: Descriptive statistics of RESPECT

B. LOOKED DOWN: Other people in my STREET/VILLAGE look down on me and my family

LOOKED DOWN CASTE	strongly agree	agree	disagree	strongly disagree	Total
SC/ST/BC Hindu	62	100	118	1,145	1,425
	0.044	0.070	0.083	0.804	
Other Hindu	6	11	13	244	274
	0.022	0.040	0.047	0.891	
Muslim	6	8	4	119	137
	0.044	0.058	0.029	0.869	
Other religion	7	6	10	84	107
	0.065	0.056	0.093	0.785	
Total	81	121	141	1,543	1,886
	0.043	0.064	0.075	0.818	

Overall, 81% strongly disagree to feel looked down upon in the community. This share is 80% and 89% for lower and upper-caste Hindus, respectively. I construct a binary variable “*Looked down*” which takes a value of 1 if parents strongly disagreed to being looked down upon and 0 otherwise.

LOOKED DOWN CASTE	0	1	Total
SC/ST/BC Hindu	1,145	280	1,425

	0.804	0.196	
Other Hindu	244	30	274
	0.891	0.109	
Muslim	119	18	137
	0.869	0.131	
Other religion	84	23	107
	0.785	0.215	
Total	454	1,477	1,931

Table A1.4b: Descriptive statistics of LOOKED DOWN

C. DISR: Combining the two variables- *Respect* and *Looked down*, I construct an index for discrimination "*DISCR*". The index takes a value of 0 if parents perceive no manifestation of discrimination (i.e. if parents strongly agree to being respected and strongly disagree to being looked down upon the community) and 1 if parents perceive any manifestation of discrimination. Table A1.4c below reports the descriptive statistics.

DISCR **CASTE**	**0**	**1**	**Total**
SC/ST/BC Hindu	923	494	1,417
	0.651	0.349	
Other Hindu	206	64	270
	0.763	0.237	
Muslim	95	40	135
	0.704	0.296	
Other religion	70	36	106
	0.660	0.340	
Total	1,294	634	1,928

Table A1.4c: Descriptive statistics of DISCR

Chapter 2:

Younger Children and Mothers' Labour Supply in Rural India: Evidence from Fertility Stopping Behaviour

"I myself would like one son.
And I don't want many children.
But it isn't a question of what I want.
Until I have a son, I won't stop having children."
-- (Clark, 2000)

2.1 Introduction

The relationship between fertility and female labour supply has received considerable attention from economists and has been widely studied. The existing evidence on the effect of fertility on mothers' labour supply has been mixed across countries with the vast majority of the empirical studies reporting a negative causal effect (see, e.g. Angrist & Evans, 1998; Fontaine, 2017; Lundborg et al., 2017; Rosenzweig & Wolpin, 1980); while some concluding positive or no causal effects (see, e.g. Aguero & Marks, 2008; Lee, 2002; Trako, 2016). More recently, Aaronson et al. (2021) using data from 103 countries between 1787 and 2015 find a negative relationship between fertility and mothers' labour supply for countries at a later stage of economic development and no effect for countries at a lower level of income.

In India, gender roles defined by society disproportionately place the onus of raising children on mothers. A number of studies have established a robust negative correlation between fertility and female labour force participation[19]. But there are no studies capturing the causal effect of fertility on mothers' labour supply in India. The mixed results observed in the literature suggest that the relationship between fertility and mothers' labour is very demographic and context-specific, thus, requiring greater attention in the Indian context.

In this paper, I estimate the causal effect of having young children aged 0 to 5 years on mothers' labour force participation in rural India wherein almost 75 percent of the female population lives (*Census*, 1991). According to the 1991 Indian Census, 80% of the female population in the reproductive age group of 15-49 years in rural India has been married at least once in their lifetime with a total fertility rate of 3.9 and among them, 89% have at least one child. Since mothers comprise a major share of the total female population, it is important to understand how fertility affects mothers' labour supply. This could bring crucial insights from a policy perspective and help policymakers to make informed policy decisions to raise female labour force participation.[20] For example, if the presence of younger children in the family inhibits mothers to work, then policies aiming to improve quality formal childcare and making it available to mothers at affordable rates and promoting smaller family size could help lift female labour supply and achieve a satisfactory work−life balance.

The main challenge involved in the estimation of the causal effect is that fertility decisions and mothers' labour supply are jointly and simultaneously determined. Mothers who decide to have (more) children are not a random subgroup of the population. For instance, women who are more family-oriented and thus, have lower labour market attachment or earnings potential, might choose to have more children. On the other hand, women who are more career-oriented and have higher labour market attachment may decide to delay motherhood and have fewer children.

To deal with this problem of endogeneity, I use the instrumental variable strategy. I exploit the preference of Indian parents to have at least one son in the family, as an instrument for having younger children. Parents without any male child aged 6+ years are more likely to have

[19] See, for ex. Bhalla & Kaur, 2011; Das et al., 2015; Klasen & Pieters, 2012, 2015

[20] According to the 1991 Indian census, the overall female labour force participation in rural India, including both full time and part time workers, was only 26.7%. Whereas the full time employment rate was 18.6%.

younger children aged 0 to 5 years as compared to parents who already have a male child. Since the gender of children is virtually randomly assigned, a dummy variable indicating whether parents already have a boy child or not aged 6+ years- conditional on the number of children - serves as a plausible instrument for further childbearing.[21]

The identification strategy is reminiscent of Angrist & Evans (1998) and Kugler & Kumar (2017), who employ gender of children as an instrument for fertility. The motivation behind using this instrument in this paper is derived from studies like Clark (2000) and Mutharayappa et al. (1997) showing that India is characterized by a patriarchal family system where parents prefer sons to daughters (also termed as son-preference) and desire at least one son in the family. In order to achieve the ideal number of sons, parents in most cases engage in son-biased differential fertility stopping behaviour and continue having children until the desired number of sons is achieved.

The contribution of this paper to the literature is three-fold. First, this is the first attempt in the Indian context to estimate the magnitude of the causal effect of fertility on mothers' labour force participation decision. Given that the existing global evidence on the effect of fertility on mothers' labour supply is very heterogeneous across countries, this paper contributes to this gap in the literature by providing an estimate on this causal relationship for India.

Second, I explore heterogeneity in the relationship between fertility and mothers' labour supply and characterize the subpopulation of mothers who are more likely to withdraw from the labour market in response to having pre-school children between 0 to 5 years of age. It is essential from a policy perspective to be able to identify mothers with the highest effects of fertility on their labour supply so that targeted policy measures can be taken to improve their labour force participation.

Third, this paper specifically focuses on capturing the magnitude of the effect of the presence of pre-school children aged 0 to 5 years on mothers' participation decision. The existing studies[22],

[21] There may be concerns about sex-selective abortions in India, in which case the instrument is no longer randomly assigned and the estimates may be biased. To address this concern, I carry out various sub-sample analysis and discuss more about this in section 2.5.2.

[22] See, for ex. Aguero & Marks, 2008; Angrist & Evans, 1998; Lee, 2002, 2002; Rosenzweig & Wolpin, 1980

covering other countries, instead, estimate the effect of total fertility on mothers' participation, i.e. effect of having an additional child on mothers' participation, without taking into account the age of the child. However, there are differential effects on the participation decision of the mother depending on the age of the children. A pre-school-aged child, for example, requires more care and attention of the mother compared to a child who is 6+ years and consequently poses more responsibility onto mothers. Also, a mother's physical presence is deemed necessary in the early years of childhood, thus, making it difficult for mothers with young children to work.

Using publicly available survey data from the two rounds of the National Family Health Survey, conducted in 1992/93 and 1998/99, I find that mothers' participation significantly reduces by 10.2% due to the presence of younger children in the household. Since the instrumental variable estimates the local average treatment effect only for the sub-sample of the population called compliers[23], I profile the compliers to understand the sub-section of women for which the IV is estimating the effect for. I find that the compliers are positively selected and significantly different from the general population. They are more likely to have higher education, belong to socioeconomically forward social groups (castes), and have educated husbands. They are less likely to be Muslims and Christians and belong to the lowest wealth quartile.

Using the heterogeneity analysis, I show that the negative effect of the presence of younger children in the family is driven by mothers with no education and mothers belonging to wealthier, upper-caste Hindu, and Muslim families. These results posit that social and cultural barriers to women's work, patriarchal controls over women's mobility and the type of work deemed suitable for women, and gender defined roles, which are stronger in wealthier, upper-caste, and Muslim households, dampen mothers' labour supply (Klasen & Pieters, 2015; Sorsa, 2015). Due to the unavailability of suitable and culturally acceptable jobs and equal pay scale in the job market,

[23] Compliers in this paper are the sub-sample of mothers who would go on to have an additional child if they do not have a boy aged 6+ but would not choose to have another child if they already have a boy aged 6+ years.

IV fails to identify the effects for always-takers (i.e. sub-population of mothers who always choose to have a younger child irrespective of having a boy child aged 6+ years already or not) and never-takers (sub-population of mothers who always choose 'NOT' to have an additional child irrespective of having a boy child among children aged 6+ years or not).

mothers tend to withdraw from the labour market until they have a compelling need to work to financially support their families.

The findings of this paper highlight the need for policies introducing skilled and female-friendly job opportunities with good and equal remunerations to incentivize mothers in rural India to work. Furthermore, investment in the quality and quantity of formal childcare facilities, schools and daycare facilities is required to help and incentivize mothers to work. And finally, publicly funded information campaigns that encourage and value women as workers and project childcare as a shared responsibility in the home, are needed to redefine the existing social norms that restrict women's economic participation.

The remainder of the paper is organized as follows. Section two reviews some relevant literature. Section three and four describe the data and methodology used in this study. Section five discusses the relevance and validity of the instrument. Section six presents the main results of the paper and finally, section seven concludes.

2.2 Literature Review

There is a vast literature on the determinants of female labour force participation in India that points towards both demand and supply-side factors in play. On the supply side, factors such as education, social group, expected wages, marital status, presence of children in the household, income level of the family are crucial determinants of female labour force participation (FLFP). On the demand side, labour market conditions like availability of jobs, infrastructure, and changes in the sectoral structure- e.g. declining share of agriculture and manufacturing which employ more women - have been found to affect female participation. This paper looks at one of the determinants of female labour supply decision, namely fertility. Because of the biologically dictated burden of childbearing and childrearing on the mothers, motherhood is an important determinant of mothers' labour supply decision.

Globally, there is an extensive literature attempting to explain the causal effect of fertility on female labour supply. The pieces of evidence have been mixed with some studies finding a very strong negative effect of fertility (see, e.g. Angrist & Evans, 1998; Fontaine, 2017; Lundborg et al., 2017; Rosenzweig & Wolpin, 1980; etc.); while some conclude no significant effect of fertility on female labour supply (see, e.g. Fleisher & Rhodes, 1979; Lee, 2002; etc.). Another study by Trako (2016) on developing country in the Balkans find that fertility, in fact, raises the labour force participation of both parents. Agüero & Marks (2011) use infertility as an instrument and investigate the causal relationship between children and female labour force participation in 26 developing countries. Their sample does not include India. They find no effect of fertility on likelihood and intensity to work. Aaronson et al. (2021) analysed data from 103 countries between 1787 and 2015 and find a negative relationship between fertility and mothers' labour supply for countries at a later stage of economic development. They find no causal effect for countries at a lower level of income, including the USA and Western European countries prior to World War II. These mixed pieces of evidence suggest that the relationship between fertility and mothers' labour supply is complex and is very culture and demographic-specific, thus, requiring greater attention for the Indian case, where this causal relationship is not yet explored.

There are several challenges in the estimation of the uni-directional effect of fertility on labour supply. First, the two phenomena may be explained by common factors such as education. The education level of mothers may influence both, their career opportunities and their childbearing behaviour. Second, there is the problem of reverse causality as both fertility and labour supply decisions are jointly determined. For example, a woman might decide not to work if there is a child to be taken care of in the house or she may decide to work to contribute to the family's income and thus, material investment in children's welfare. On the other hand, an ambitious woman wishing to work may decide to delay motherhood (or have fewer children), or alternatively, a woman with lesser labour market attachment might self-select into motherhood and have more children. Because of this endogeneity problem, simple OLS would generally provide biased estimates (Killingsworth & Heckman, 1986).

Many papers use instrumental variable and difference-in-difference estimation to tackle this problem of endogeneity. In the literature, the following two empirical strategies have been commonly used to handle this endogeneity problem by exploiting an exogenous source of variation in the number of children through the Instrumental Variables technique. The first strategy proposed by Rosenzweig & Wolpin (1980) exploits the natural occurrence of multiple first births as an exogenous source of variation in the number of children to estimate the effect of fertility on parents' labour supply. The second strategy, first introduced by Angrist & Evans (1998), exploits the preference for mixed sex-composition of the children of American parents. They proposed that parents of same-sex siblings are more likely to have an additional child and thus, use this as an instrument for having a third child among women with at least two children.

Preference for Sons in India

In this paper, I exploit the prevalence of son preference in Indian society as an exogenous source of variation in the presence of young children aged 0 to 5 years. The term 'son preference' refers to the attitude that sons are more important and more valuable than daughters (Clark, 2000). In India, for example, adult sons are expected to provide economic support for their parents (N. Das, 1984, 1986, 1987). In contrast, daughters may represent a substantial economic burden in places where their parents provide a dowry. The bridal dowry practice also often entails the loss or mortgage of family land at the time of a daughter's marriage.

Marriages in India are exogamous for women, who leave their natal family village to marry into families in villages much further away to avoid marrying a possible relative. Sons, on the other hand, are expected to care for parents and natal family members in their old age by remaining with the natal family and working on the family land. Thus, Indian families express a strong preference for having at least one son, and often two, among their children (Mutharayappa et al., 1997).

Parents often engage in son-preferring Differential Stopping Behaviour (DSB) and continue having children until the ideal number of sons are achieved. Some studies find couples with more sons more likely than couples with more daughters to use contraception because they do not want more children (Clark, 2000). The birth of a daughter with no older brothers causes her parents to exceed their intended fertility (Jayachandran & Pande, 2017). Kugler & Kumar (2017) exploit this preference to explore quantity-quality tradeoff of children and instrument family size with the gender of the first child, as parents tend to have more children if the firstborn is a girl.

A woman from a village in India when asked about her plans to have children, said "I myself would like one son. And I don't want many children. But it isn't a question of what I want. Until I have a son, I won't stop having children" (Clark, 2000). This statement itself hints towards the intense and strong desire for sons in rural India. I leverage exogenous variation in the gender of older children aged 6+ years as an instrumental variable for having younger children aged 0 to 5 years in the family.

2.3 Data

I use data from the two waves of the National Family Health Survey (NFHS) conducted in 1992/93 and 1998/99. NFHS is a nationally representative survey of 89,777 ever-married women in the age group 13-49 years. Data are publicly available through the Demographic Health Survey Program (DHS). The survey contains a wide range of information on fertility, family planning, mortality, and maternal and child health.

I limit the analysis to married mothers in rural India, aged between 15 and 49 years old with at least one child aged 6+ years and no children aged 18+ years. Women without any children older than 5 years at the time of the survey are excluded from the sample because the identification strategy exploits the gender of children aged 6+ years in the family as the instrument for having younger children aged 0 to 5 years. Mothers with children older than 18 years at the time of the survey are also excluded from the sample because of the following two reasons. Firstly, for these women, it is highly likely that their elder children start working or move out of the household which may affect the participation decision of mothers through channels other than through the presence of younger children. Secondly, these women are less likely to have very young children aged 0 to 5, which is the variable of interest. In my data, only 17% of mothers with children over 18 years have young children aged 0 to 5 years, whereas this number is 39% for mothers without children over 18 years. The sample excludes divorced/separated women as they may be the sole breadwinner in the family.

I also carried out some data consistency checks and eliminated mothers for whom the number of reported family members excluding their own children was zero or negative. The final sample consists of 51,118 observations of rural mothers aged 15-49 years, having at least one child aged 6+ years and no children older than 18 years.

Descriptive Statistics

Demographic and labour-force participation descriptive statistics for the mothers are reported in Table 2.1. The table includes variables such as mothers' age, education, household size excluding own children, religion, caste, among others. Descriptive statistics of the data indicate that the labour force participation rate in rural India for mothers aged 15-49 with at least one child above 6 years and no child above 18 years is only 41% (Table 2.1). The mean age for

Table 2.1: Descriptive Statistics.

Variable	Mean	Std. Dev.
Work (Dep variable)	0.412	0.002
Number of children	3.164	0.006
Any child aged 0 to 5 years (kid0_5)	0.574	0.002
No son aged 6+ (noson6plus)	0.232	0.002
Number of kids aged 6+ (Nkid6plus)	2.348	0.005
No daughter aged 6+ (nodaught6plus)	0.281	0.002
Age	30.120	0.022
Education		
None (Years of education=0)	0.646	0.002
Primary (1 to 5 years)	0.159	0.002
Secondary (6 to 10 years)	0.167	0.002
Higher secondary (11 and 12)	0.017	0.001
Tertiary (13 and above)	0.011	0.000
Husband's education		
None (Years of education=0)	0.354	0.002
Primary (1 to 5 years)	0.199	0.002
Secondary (6 to 10 years)	0.334	0.002
Higher secondary (11 and 12)	0.060	0.001
Tertiary (13 and above)	0.052	0.001
Religion		
Hindu	0.791	0.002
Muslim	0.102	0.001
Christian	0.059	0.001
Other religion	0.048	0.001
Caste		
Scheduled Caste (SC)	0.156	0.002
Scheduled Tribe (ST)	0.151	0.002
General/forward caste	0.693	0.002
Wealth index	-0.046	0.004
Mother-in-law in HH	0.037	0.001
Family size excluding own children	4.150	0.016
Observations	51,118	

Notes: This table reports the descriptive statistics for the sample of mothers aged 15-49 years with at least one child aged 6+ years and no children aged 18+ years.

the sample of mothers is 30 years and 65% of mothers have no education. Mothers in the sample have on average 3.16 children, and 57% of them have at least one child aged 0 to 5 years.

There is a strong correlation between the presence of young children and mothers' labour supply as shown in Table 2.2. The labour force participation rate for mothers with no children aged 0 to 5 years is 44.76%, whereas it is only 38.6% among mothers with younger children. The difference in the participation rate for mothers with and without pre-school aged children is statistically significant at the 1% level.

Table 2.2: Participation rate among mothers with and without younger children aged 0 to 5 years.

	Sample of mothers		
	Without kids aged 0 to 5 years (1)	**With kids aged 0 to 5 years (2)**	**Difference (1)-(2)**
Work	0.447	0.386	0.061***
Observations	9,730	11,351	

*Notes: This table reports the participation rates for mothers with and without a child aged 0 to 5 years. The sample includes mothers aged 15-49 years with at least one child aged 6+ years and no child aged 18+ years. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

The data also indicates that fertility is not randomly assigned among women and there may be potential self-selection involved into childbearing and fertility. Total fertility of mothers decreases with higher education, as shown in panel A of Table 2.3. Uneducated women have average fertility of 3.33, whereas, among women with tertiary education, the average fertility is 2.20. Also, lesser-educated women have on an average higher number of younger children aged 0 to 5 years.

Indian society is characterized as highly patriarchal and co-residence of women with parents-in-law is ubiquitous, especially in rural India where most of the families are involved in family farming activities. There is evidence from the past literature that mothers-in-law in the household could affect the fertility decision of women through various channels such as providing childcare support and imposing their own preference for the number of grandchildren and their gender on daughter-in-law. Panel A of Table 2.3 shows a strong association between the presence of mother-in-law in the household and fertility. About 68% of women residing with mothers-in-law have younger children, while only 57% of women without mothers-in-law residing in the same house have younger children aged 0 to 5 years. Further, women residing with their mothers-in-law have on average a higher number of younger children aged 0 to 5 years as compared to women not residing with their mothers-in-law.

Also, women with educated spouses tend to have a lesser number of children on average as compared to mothers with uneducated or lowly educated husbands (Table 2.3, panel B).

2.4 Empirical Model: Female Labour Supply

First, I estimate the effect of family size on children's educational outcomes using the following ordinary least squares (OLS) model:

$$\boldsymbol{Work_i} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\ \mathbf{kid0\_5}_i + \boldsymbol{\gamma}\ \mathbf{X}_i + \boldsymbol{\mu_i} \qquad \textbf{(2.1)}$$

'$Work_i$' is a binary variable for mothers' participation in the labour market. It takes the value 1 if the mother reports being employed and takes 0 otherwise. Variable '$kid0\_5_i$' is the independent variable of interest and captures the presence of pre-school children aged 0 to 5 years. It takes the value 1 if the mother has a young child aged 0 to 5 years and 0 otherwise. X_i is the vector of individual and household level covariates and state fixed effects and μ_i is the error term. Coefficient β_1 captures the correlation between the presence of pre-school children and mothers' participation.

Next, to estimate the causal effect of having younger children aged up to 5 years on mothers' labour supply decision, I estimate the following two-stage least square (2SLS) model.

First stage equation:

$$\boldsymbol{kid}\mathbf{0\_5}_i = \boldsymbol{\alpha} + \boldsymbol{\beta}\ \mathbf{noson6plus}_i + \boldsymbol{\gamma}\ \mathbf{X}_i + \boldsymbol{\omega_i} \qquad \textbf{(2.2)}$$

Structural equation:

$$\boldsymbol{Work_i} = \boldsymbol{\delta} + \boldsymbol{\theta}\ \boldsymbol{kid}\mathbf{0\_5}_i + \emptyset\ \mathbf{X}_i + \boldsymbol{\varepsilon_i} \qquad \textbf{(2.3)}$$

Table 2.3: Evidence of potential self-selection into childbearing

Panel A: Education and presence of mother-in-law

	Mothers with different education level					Mother-in-law in the household	
	None	Primary	Secondary	Higher sec	Tertiary	No	Yes
# of children	3.330	3.070	2.748	2.472	2.199	3.164	3.182
Any Kid 0 to 5	0.618	0.514	0.486	0.449	0.426	0.570	0.678
# kids aged 0 to 5	0.892	0.727	0.653	0.574	0.493	0.809	0.991
Work	0.469	0.342	0.266	0.312	0.463	0.412	0.423
Observations	33,026	8,129	8,538	881	544	49,203	1,915

Panel B: Husband's education level

	Husband's education				
	None	Primary	Secondary	Higher sec	Tertiary
# of children	3.329	3.196	3.066	2.970	2.785
Any Kid 0 to 5	0.627	0.551	0.551	0.550	0.488
# kids aged 0 to 5	0.905	0.781	0.779	0.757	0.656
Work	0.511	0.453	0.330	0.272	0.277
Observations	18,102	10,182	17,094	3,073	2,667

Notes: The tables report the evidence towards self-selecting into childbearing. The average number of total children, presence of children aged 0 to 5 years, no. of children aged 0 to 5 years and participation rate are reported for mothers with different education levels; husband's education; and residing with/without mother-in-law in the household. The sample consists of mothers aged 15-49 years with at least 1 child aged 6+ and no child over 18 years.

Variable $'kid0\_5'$ is the independent variable of interest and captures the presence of children aged 0 to 5 years. Since this variable is endogenous to the mothers' participation, I instrument it with $'noson6plus'$ which indicates that the mother doesn't have a son aged 6+ already. This instrument is drawn from the literature indicating that Indian parents are "son preferring" and desire at least one boy child in the family. In this context, mothers without a boy child are more likely to have another child. Variable '*noson6plus'* is a binary variable indicating whether the mother already has a boy child aged 6 or above. It takes the value 1, if the mother doesn't have a son aged 6+ and 0, otherwise. β is the first-stage estimate and captures the effect of not having a son aged 6+ on the probability of having a younger child aged 0 to 5 years.

X is a vector of the following control variables and is drawn from the literature on the determinants of female labour force participation in the Indian context. I control for a) '*Nkid6plus'* capturing the total number of children aged 6+ years as the presence of a son aged 6+ years mechanically depends on the total number of children aged 6+ years a woman has[24];

b) Household wealth as proxied by- i) quintiles of wealth index and ii) husband's education;

c) Other individual-level characteristics like *age*, *age squared and education level;*

d) Social groups like *caste* and *religion* to capture the direct impacts of culturally or religiously determined restrictions on women, which are expected to be strongest among Muslim and high-caste Hindu households (Klasen & Pieters, 2015);

e) Variables for household composition: i) binary variable indicating the presence of a daughter aged 6+ (no*daught6plus*), ii) whether the mother-in-law resides in the household (*MIL_in_HH*), and iii) family size excluding woman's own children; and

and f) survey round and state fixed effects.

[24] As robustness checks, I tried regressions with 1) the quadratic terms of Nkid6plus; and 2) a full factorial of Nkid6plus, to capture the non-linearity. But they turn out to be insignificant and increase the standard error of the estimates. I also use mother's age fixed effects as a proxy for Nkid6plus and the estimate is robust.

2.5 Instrument relevance and validity

2.5.1 Instrument relevance: the first stage

Estimation using the instrumental variable requires that the instrument is relevant. In my application, this would mean that not having a son aged 6 or above is strongly correlated with the presence of a young child aged 0 to 5. I regress the endogenous variable, kid0_5, on the instrument, noson6plus, controlling for various covariates discussed above. The results indicate that not having a male child increases the probability of having younger children by 18.5% (Table 2.6, column 1), statistically significant at the 1% level. The first stage F-statistics is 1051. The full results of first-stage regression are reported in Table A2.1 of the appendix.

I also carry out various sub-sample analyses to confirm a strong son preference. The results are reported in Table 2.4. For the sub-sample of mothers with one child aged 6+ years, not having a boy child increases the probability of having an additional child aged 0 to 5 years by 3.7%. Among mothers with two children aged 6+ years, mothers with mixed-sex and two daughters are 10.1% and 26.8% more likely to have another child aged 0 to 5 years, respectively, as compared to mothers with two sons. For the sample of mothers with at least two children aged 6+, mothers with mixed-sex children and all daughters are 6.1% and 29.8% more likely to have another child aged 0 to 5 years as compared to mothers with all sons. The estimates are significant at the 1% level. Corroborating with the fact that Indian parents exhibit strong son-preferring behaviour, parents with all daughters go on to have more children in the hope of having at least one male child in the family. Parents with a mixed-sex composition of children, as well, are more likely to go on to have more children as compared to parents with all sons. The results highlight that the preference for sons is significantly stronger than the preference for the mixed-sex composition of children or the preference for daughters, upholding the relevance of the instrument.

2.5.2 Instrument validity

In addition to the instrument being relevant, it should also be as good as random. Even though the presence of a boy child aged 6+ years conditional on the number of children aged 6+ years is plausibly randomly assigned, there exist some concerns. One concern is the presence of sex-selective abortions. In this case, the instrument is no longer randomly assigned and the estimates are biased. In the context of India, this is an important concern as India is a highly son-preferring society with a sex ratio of children less than 7 years biased towards males.

Over time, the overall Male-to-Female sex ratios for children aged 0-6 years has fallen drastically from 962 girls per 1,000 boys in 1981 to 945, 927, and 918 girls per 1,000 boys in the three successive Censuses of 1991, 2001, and 2011, respectively (Jejeebhoy et al., 2015). This gender imbalance has been attributed to neglect of girls in the early years and the widespread of ultrasound technology in the 1990s resulting in sex-selective abortions. Ultrasound scanners were first introduced in the 1980s with the onset of a period of economic liberalization and became accessible to the general population in the mid-1980s. In the mid-1990s, large scale domestic production of ultrasound scanners was initiated resulting in steep acceleration in sex selection after 1995 (Bhalotra & Cochrane, 2010).

Since, I use NFHS surveys conducted in 1992/93 and 1998/99 and exploit the gender of children aged 6+ years, who were born well before 1995, the concern of sex selection remains relatively minor in my sample.[25]

Nonetheless, I check whether the instrument is as good as random via balancing check, i.e. examine whether mothers differ in demographic characteristics by the instrument, controlling for the total number of children aged 6+ years (as the presence of younger children aged 0 to 5 years mechanically depends on the number of children women already has) and state fixed effects. Table 2.5 reports the difference in means in the demographic characteristics of mothers with and without a son aged 6+ years, controlling for the state fixed effects and the number of children aged 6+. I do not find any significant difference in terms of years of education, husband's years of education, and presence of mother-in-law. However, there is a significant difference in terms of the demographics like age, wealth, family size excluding own children, and social group. Mothers with a son aged 6+ years are significantly more likely to have higher wealth, older by approx. 0.63 years or 7.6 months, and belong to a smaller family. Also, mothers with a son aged

[25] Also, according to the Indian Census of 1991, the male-to-female sex ratio was 1.058 which is within biologically natural sex ratio range of 1.03 to 1.07.

Table 2.4: Validation analysis for son-preference in India

Dep Variable: Kid0_5	Pooled sample of all mothers	Mothers with one child aged 6+	Mothers with two children aged 6+		
			All sex composition	Sub-sample with two sons or mix-sex composition	Sub-sample with Two daughters or mix-sex composition
First-stage	(1)	(2)	(3)	(4)	(5)
All daughters aged 6+	0.163***	0.037***	0.268***		
Mix-sex composition aged 6+			0.101***	0.099***	-0.169***
Observations	51,118	15,047	15,292	12,227	10,795

Dep Variable: Kid0_5	Mothers with at least two kids aged 6+ years		
	All sex composition	Sub-sample with all sons or mix-sex composition	Sub-sample with all daughters or mix-sex composition
First-stage	(6)	(7)	(8)
All Daughters aged 6+	0.298***		
Mix-Sex composition aged 6+	0.061***	0.065***	-0.238***
Observations	36,071	31,427	29,544

*Notes: This table reports the estimates of the likelihood of having a child aged 0 to 5 years for various sub-samples of mothers with different sex-composition of children aged 6+ years, i.e. all sons, mix-sex or all daughters. The pooled sample consists of 51,118 mothers from rural India, aged 15-49 years. All the specifications include controls listed in section 2.4. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%*

6+ years are significantly more likely to belong to general/upper-caste and less likely to be Muslim.

Table 2.5: Statistical Test for Balance

Variable	Unconditional mean (noson6plus (Z)=0)		Difference conditional on Nkid6plus and States		Percentage
Age	30.699	(4.907)	-0.636***	(0.049)	2.072
Wealth index	-0.040	(0.938)	-0.017*	(0.010)	42.500
Mother-in-law in HH	0.037	(0.188)	-0.001	(0.002)	2.703
Family size excluding own children	4.033	(3.572)	0.139***	(0.040)	3.447
Years of education	2.261	(0.018)	-0.038	(0.039)	1.681
Husband's years of education	5.058	(0.024)	-0.075	(0.052)	1.485
Religion					
Hindu	0.789	(0.408)	-0.006	(0.004)	0.760
Muslim	0.103	(0.304)	0.007**	(0.003)	6.796
Christian	0.060	(0.237)	-0.003	(0.002)	5.000
Other religion	0.049	(0.216)	0.001	(0.002)	2.041
Caste					
Scheduled Caste (SC)	0.156	(0.363)	0.005	(0.004)	3.205
Scheduled Tribe (ST)	0.151	(0.358)	0.008**	(0.003)	5.298
General/forward caste	0.693	(0.461)	-0.013***	(0.005)	1.876
Observation:	39,242		51,118		

*Notes: This table reports the unconditional mean of each variable for mothers with a son aged 6+ years (i.e. when instrument is switched off, Z=0); balance statistics computed by regressing covariates on the instrument "not having a son aged 6+ years (noson6plus)", controlling for the number of children aged 6+ years, survey round and the state fixed effects; and the size of this difference in percentage terms. The standard errors are reported in parenthesis. The sample consists of 51,118 mothers from rural India, aged 15-49 years with at least one child aged 6+ years and no child over 18 years. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

These significant differences hint towards the possibility of the prevalence of sex-selective abortions in favour of sons in certain sub-populations. To address this potential issue of sex-selective abortions, firstly, I control for variables like caste, religion, women's age, wealth index, presence of mother-in-law, and family size in all my empirical specifications to account for the differences in observables across mothers with and without a son aged 6+ years.[26]

[26] Identification using IV requires assumption of *conditional independence*. This assumption expresses the idea that the instruments are "as good as randomly assigned," conditional on covariates.

Secondly, I carry out the analysis on a sample of mothers with only one child aged 6+. Previous research shows that the sex of the firstborn child is as good as random (for ex. see, Almond & Edlund, 2008; Anukriti et al., 2016; Bhalotra & Cochrane, 2010; Kugler & Kumar, 2017).[27]

Thirdly, I carry out a separate analysis on Muslim mothers who are less likely to engage in sex-selective abortions due to a greater abhorrence of abortion (Almond et al., 2013; Almond & Edlund, 2008).[28]

Finally, I carry out analysis on a sub-sample of mothers from weaker son preference regions and with at most two children aged 6+ years. Using the 1981 Indian census, I define local son preference as the male-to-female ratio (MFR) of children aged 0 to 6 years in the rural areas of each Indian state in 1981[29]. Since sex selection is expected to be more prevalent at higher birth orders and in high son preferring regions, I limit my sample to mothers from regions with below-median MFR and with at most two children aged 6+ years.

Next, the exclusion restriction requires that the presence of a son aged 6+ years should not have a direct effect on mothers' labour force participation other than through its impact on fertility. A possible threat to the validity of this assumption is the potential differential involvement of mothers in the care of pre-existing sons and daughters aged 6+ years. This would imply that mothers respond differently in the presence or absence of male children aged 6+

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[27] According to Jha et al. (2011), the sex ratio for firstborns and for second-order births with firstborn boy did not change between 1990 and 2005, staying near the natural range of 1.03-1.07 (950–975 girls per 1000 boys).

Using United States census data for Indian, Korean and Chinese parents, Almond & Edlund (2008) find that sex-ratio of oldest child is biologically normal, but that of subsequent children is heavily male biased, especially when there was no previous son.

[28] Previous studies have documented that the extent of practice of sex-selective abortion varies significantly across different religions. Muslims, who comprise 14% of India's population, show no significant increase in male-biased sex ratios in the post-ultrasound period. This is attributed to the greater abhorrence of abortions among Muslims (Bhalotra et al., 2018). Using Canadian census data, Almond, Edlund, & Milligan (2009) find that Hindu and Sikh immigrants exhibit male-biased sex ratios while Muslim and Christian immigrants from South Asia instead have larger family sizes. The strong condemnation against infanticide expressed in Christianity and Islam carry over into significantly lower degrees of prenatal sex selection among members of these religious groups (Almond, Edlund, & Milligan, 2009). While immigrants of Christian or Muslim religion preferred sons as evidenced by continued fertility following only daughters, there is little evidence of sex selection (Almond & Edlund, 2008)

[29] MFR for children aged 0 to 6 years in 1981 captures regional/local son preference prior to the availability of ultrasound facility, as families exercised son preference through discrimination against girls in infancy and during childhood, and therefore, is independent of any supply driven changes in availability/access to sex-selection technology.

years. For example, by increasing their labour supply for improving financial investment in sons or reducing labour supply for investing more time in sons and thus, threatening the validity of exclusion restriction.

To check if there are differences in labour supply of mothers with and without a son aged 6+, I compare the labour supply of mothers who have most likely completed their fertility (thus, first-stage is nil for them) and have the same number of children but different sex composition of children aged 6+ years, i.e. mothers with and without a son aged 6+ years. The analysis is described in detail in section 2.6.2.

2.5.3 Monotonicity

Identification of the LATE with instrumental variables also requires the "monotonicity" assumption, stating that there shall be no defiers in the population (Imbens & Angrist, 1994). In my application, this boils down to assuming that not having a son aged 6+ can only make mothers more likely to have an additional younger child. That is to say, there are no mothers with a preference for daughters. Given the ubiquity of son-preference in the Indian context, the assumption about the absence of defiers seems plausible.

However, recent literature has proved that IVs are still valid under a weaker condition than monotonicity (de Chaisemartin, 2017). IV estimation can tolerate the presence of some defiers. In this paper, I also comment on how many defiers can be tolerated in this analysis for the LATE to hold for compliers. The results can be found in the appendix in section A2.10.

2.6 Estimation Results

2.6.1 Main Results

This section presents the main results of the effect of having younger children aged 0 to 5 years on mothers' labour supply. I use the binary variable 'noson6plus', indicating that the mother does not already have a boy child aged 6+ years, as an instrument for the presence of young children. Table 2.6 reports the main result from OLS and IV regression.

Table 2.6: Results from the main specification

VARIABLES	(1) OLS	(2) First stage	(3) Reduced Form	(4) IV
kid0_5	-0.039***			-0.102***
	(0.005)			(0.032)
noson6plus		0.185***	-0.019***	
		(0.006)	(0.006)	
Observations	51,118	51,118	51,118	51,118
State FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
R-squared	0.183	0.234	0.182	0.067
First-stage F stat for instrument relevance		1051		

*Note: This table reports the OLS, first-stage, reduced form and 2SLS estimates from the main specification. The endogenous independent variable of interest is- having a child 0 to 5 years (kid0_5) and is instrumented with- not having a son aged 6+ years (noson6plus). The dependent variable of interest is mothers' participation (Work). The sample includes mothers aged 15-49 years with at least one child aged 6+ years and no child over 18 years. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

The OLS estimates (Table 2.6, column 1) provide the average treatment effect of the presence of young children on mothers' participation. The results indicate that after controlling for other covariates, mothers with pre-school children aged 0 to 5 are on average 3.9% less likely to work. This is statistically significant at the 1% level. As discussed above, the OLS estimation does not take into account the problem of endogeneity between fertility and mothers' labour force participation. Thus, the estimates are biased and provide a mere correlation between fertility and mothers' labour supply.

Under the assumptions discussed above, IV estimates solve the problem of endogeneity and provide the local average treatment effect for the compliers. Using the IV estimation, I find that the effect of the presence of younger children aged 0 to 5 years reduces the participation of the mothers by 10.2% which is statistically significant at the 1% level. The first-stage is highly significant with an F-stat of 1051. Column (2) shows that not having a son aged 6+ is associated with an 18.5% more likelihood of the presence of younger children aged 0 to 5 years.

Table A2.1 in the appendix also reports the effects of other covariates on fertility. Women's education has expected effects. Less-educated women are less likely to work than women with no education, but high-educated women with tertiary education are more likely to work indicating a U-shaped relationship between education and female labour force participation.

Women's participation decreases with husband's education and family size. With respect to the social groups, I find that upper/general caste women are less likely to work as compared to socioeconomically backward SCs and STs. The impact of religion appears to be stronger with Muslim women less likely to work by around 12.9% and Christian women 3.1% more likely to work compared to upper-caste Hindu women.

2.6.2 Robustness Checks

To test the robustness of estimates to various specifications of the control function, I also run models including various interactions of the variable 'noson6plus' with other variables like religion, number of children aged 6+ (Nkid6plus), and presence of daughter aged 6+ (daught6plus) as instruments and the estimates are consistent (Table A2.2 in the appendix). I also introduced non-linear terms for the number of children aged 6+ years (Nkid6plus), which turn out to be insignificant and the estimate is robust. I also use mother's age fixed effects in place of Nkid6plus to proxy the number of children aged 6+ and the estimate of the causal effect of fertility on mothers' labour force participation is 10.8%.

I also carry out the analysis using three alternative definitions of work- 1) whether the mother works outside/away from home or not; 2) whether the mother works for someone outside the family; and 3) whether the mother receives money for her work. The results are reported in Table A2.3 in the appendix and the estimates are always negative and statistically significant.

The estimates are also robust to the clustering of standard errors at the primary sampling unit level (PSU)[30]. Further, I also introduce the age of the eldest child (among children aged 6+) as an

[30] IV estimate is -0.116 statistically significant at the 1% level, i.e. mothers' labour supply decreases by 11.6% due to presence of younger children. Results available upon request.

additional control to control for any effect of childcare given by elder sibling to the younger sibling and the estimate is robust to this inclusion.

As a robustness check, I also carry out the analysis on the sample including the women with children aged 18+ years. The number of observations rises to 78,056. In this case, the presence of younger children reduces mothers' participation by 10.4%, significant at the 1% level. The results are reported in Table A2.4 in the appendix.

As described in the paper before, in order to take into account the issue of the prevalence of sex-selective abortions in India, I run the sub-sample analysis on women with one child aged 6+ as sex-selective abortions are prevalent at higher parities in India and the gender of firstborns is as good as random. The results indicate that the presence of younger children reduces the participation of mothers by 38.3% and this effect is significant at the 10% level. For the sub-sample of Hindu women with one child aged 6+ years, the presence of young children reduces others' labour supply by 50%. Next, I also carry out the analysis on a sub-sample of Muslim women as they are less likely to engage in selective abortions due to religious reasons. The results indicate that the presence of younger children reduces the participation of mothers by 39.9%, significant at the 5% level. Finally, for the sample of mothers from weaker local son preference and at most two children aged 6+, the effect is 26.7%, significant at the 1% level. Estimates are reported in Table A2.5 in the appendix.

To check the robustness of estimates to the concern about potential differential involvement of mothers in the care of pre-existing sons and daughters aged 6+ years, that threatens the validity of exclusion restriction, I execute various sub-sample analyses. Firstly, I restrict the sample to mothers who reported to be sterilized at least 6 years ago, as these mothers are most likely to have completed their fertility 5 years back and are less likely to have children aged 0 to 5 years. Secondly, I further restrict these women to mothers aged 40+ years and sterilized at least 6 years back.

In each of the three samples described above, as expected I find that the first stage is absent, i.e. not having a son aged 6+ years does not make mothers any more likely to have another child aged 0 to 5 years. Then, I compare the labour supply of mothers with and without a son aged 6+

years, conditional on the total number of children aged 6+ years and other controls. I also carry out this analysis separately by splitting the sample by the number of children aged 6+ years (i.e. mothers with 1, 2, 3, 4 and 5+ number of children aged 6+ years). This comparison would tell if mothers with and without a son aged 6+ years behave differently in terms of labour supply in presence of sons versus no sons. I do not find any significant difference in the labour supply for mothers with and without a son in all the above samples, thus, holding the validity of exclusion restriction. The first stage and reduced form results are reported in Table A2.6 of the appendix.

Finally, I also investigate the possibility that the treatment is correlated with unobservables by using the test recently developed by Oster (2019). Firstly, I compute bounds for the first-stage and reduced-form estimates in two polar cases. In the first case, there are no unobservables and the empirical model is correctly specified and in the second case, selection on unobservables is as high as the selection on observables (called Beta). If zero can be excluded from the bounding set, accounting for unobservables does not change the direction of our estimates and the estimates are robust to omitted variable bias. Secondly, I estimate the degree of selection on unobservable that would be required to drive the ITT estimates to 0 (called Delta, $\tilde{\delta}$). For instance, in our case, one of the omitted unobservable variables could be sex-selective abortions. The results of this analysis are reported in Table A2.7 in the appendix. Reassuringly, the estimate and the bound have the same sign for both the first-stage and the reduced form. The results indicate that assuming that the selection on unobservables is as high as the selection on observables, the first stage as well as reduced form coefficients are stable and robust to omitted variable bias, conditional on state fixed effects and the number of children aged 6+ years. I also find that the selection on unobservables should be at least 2.596 times of selection on observables (i.e. $\tilde{\delta} = 2.596$) to drive the first stage estimate to zero. And for the reduced-form estimate, $\tilde{\delta}$ is 987.10 These results from Oster tests lower the concern regarding the omitted variable bias and raise the confidence in the IV estimates' stability.

2.6.3 Average Causal Response

Table 2.7 below reports the number of children aged 0 to 5 (Nkid0_5) among the sample of mothers aged 15-49 years with at least one child aged 6+ and no child aged 18+ years. Until now we looked at the weighted average of the causal effect of the presence of children aged 0 to 5 years on mothers' participation decision. But this effect also captures the cumulative effect of having more than one child aged 0 to 5 years. In this section, I describe the weighting function that tells us how the compliers are distributed over the range of Nkid0_5, i.e. the relative size of the group of compliers with Nkid0_5=1, Nkid0_5=2, and so on.

Firstly, I carry out the analysis of the effect of the number of children aged 0 to 5 years (Nkid0_5) on mothers' participation rate by instrumenting Nkid0_5 with noson6plus. The results are reported in Table A2.8 in the appendix. The first stage is significant and indicates that not having a son aged 6+ years increases Nkid0_5 by 0.34, significant at the 1% level. The IV estimate suggests that an increase in Nkid0_5 reduces participation by 5.6 percent significant at the 5% level.

Next, I estimate the average causal response (ACR) weighting function. ACR weighting function can be consistently estimated by comparing the CDF of the endogenous variable (i.e. Nkid0_5) with instrument (noson6plus) switched off and on. The weighted function is normalized by the first stage (J. Angrist & Pischke, 2009).

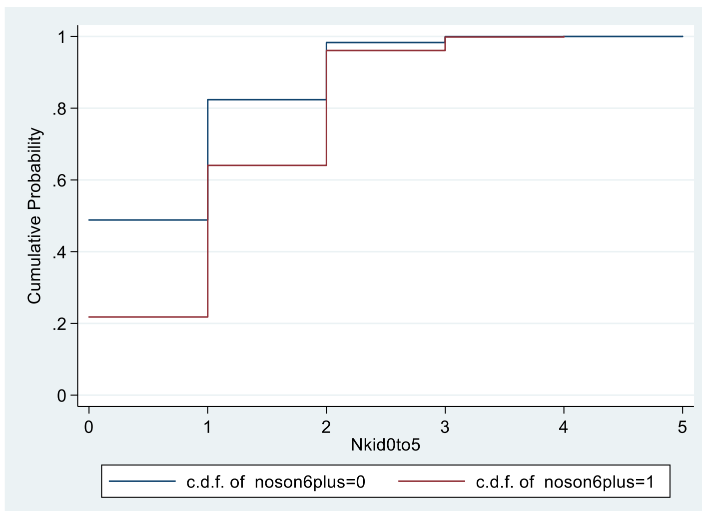
Figure 2.1 plots the CDF of the number of children aged 0 to 5 years (probability that the number of children aged 0 to 5 is less than or equal to the value of Nkid0_5 on the X-axis) for mothers with and without a son aged 6+ years. The difference between the CDF normalized by the first stage gives the weights of each value of Nkid0_5 in the 2SLS estimation. The CDF differences decline with the number of children aged 0 to 5 and become almost 0 at Nkid0_5 equals 3 and 4. The mothers with a son aged 6+ years are 40% more likely to not have a child aged 0 to 5 years. Whereas, mothers without a son aged 6+ are almost 19% more likely to have a child aged 0 to 5 years and 3-4% more likely to have 2 children aged 0 to 5 years. Thus, the 2SLS estimate in this paper is mostly capturing the effect for mothers with 1 and 2 children aged 0 to 5 years on mothers' labour supply.

Table 2.7: Number of children aged 0 to 5 years.

Nkid0_5	Freq.	Percent	Cum.
0	21,752	42.55	42.55
1	18,179	35.56	78.12
2	10,058	19.68	97.79
3	1,092	2.14	99.93
4	35	0.07	100
Total	51,118	100	

Note: This table reports the number of children 0 to 5 years in the sample of mothers.

Figure 2.1: Average Causal Response Weighting function



Note: The figure plots the CDF of the number of children aged 0 to 5 years (Nkid0to5) with the instrument switched off and on, i.e. for noson6plus=0 and noson6plus=1. The difference in the CDF depicts the weights for the range of Nkid0_5.

2.6.4 More on compliant population

As mentioned before in the paper, IV estimates capture only the LATE for compliers. Compliers are the subgroup of the population who change their behaviour because of the change in the instrument. In this study, compliers are the mothers who go on to have an additional child if they do not have a son aged 6+ but would not choose to have another child if they already have a boy aged 6+ years. In this section, following Angrist & Pischke (2009) and Angrist & Fernández-Val (2010), I say as much as possible about the compliers for the instrument 'noson6plus' used in this paper.

First, I comment on the size of the complier group and the proportion of compliers in the treated and untreated population. The ingredients for this analysis are reported in Table 2.8. I find that the proportion of compliers in the population, as given by the first stage is 18.5%. Among the treated population, i.e. mothers with a pre-school aged child, compliers comprise 7.5%. These are the mothers who went on to have another child because they did not already have a son aged 6+ years. Compliers, among the untreated population, comprise 33.4%. These are the mothers who did not have an additional child because they already had a son aged 6+ years.

Table 2.8: Counting Compliers

					Compliance Probability	
Endogenous variable (D)	**Instrument (Z)**	**P[D=1]**	**First stage P[D1>D0] Total compliers**	**P[Z=1]**	**Pr(C|D=1) Compliers among treated**	**Pr(C|D=0) Compliers among untreated**
kid0_5	noson6plus	0.575	0.185	0.232	0.075	0.334

Notes: This table reports the share of compliers in the whole population (as given by the first stage) as well as the share of compliers among treated (mothers with children aged 0 to 5 years) and untreated population (mothers without children aged 0 to 5 years). Compliers are the sub-population of mothers who are son-preferring and would go on to have another child if they do not have a son aged 6+ years and would not have an additional child if they already have a son aged 6+ years.

Since the share of compliers in the treated and untreated population is well below 1, I look at the characteristics of compliers to understand the sub-sample of mothers the instrumental variable is making inference about. If compliers are similar to the general population, the case for extrapolation of causal effect of the presence of younger children aged 0 to 5 years on mothers' labour supply to other sub-populations called always takers and never takers is stronger. Table 2.9 below reports the compliers' characteristics ratios for mothers' age, education, husband's education, religion, caste, family composition and wealth level. A significant ratio greater than 1 indicates that compliers are more likely to have that characteristic as compared to the general population. The results suggest that the compliers are positively selected and their population is significantly very different from the general population. For instance, compliers are less likely to be Muslims and Christians and less likely to belong to the lowest wealth quartile. They are more likely to be highly educated, have an educated spouse, belong to upper-caste, have more than 2 children aged 6+, and have at least one daughter in the household, as compared to the general population.

Table 2.9: Complier Characterization

Characteristics	Ratio	Std Error of ratio	P-val (ratio=1)
Age-above 30 years	1.711	0.057	0.000
Mother-in-law in HH	0.760	0.157	0.125
Wealth index			
Bottom quartile	0.908	0.029	0.002
Second quartile	1.006	0.029	0.037
Third quartile	1.039	0.029	0.179
Top quartile	0.997	0.029	0.944
Education			
None	0.780	0.024	0.000
Primary	1.137	0.073	0.060
Secondary	1.393	0.069	0.000
Higher secondary	1.531	0.225	0.018
Tertiary	1.729	0.257	0.005
Husband's education			
None	0.756	0.023	0.000
Primary	0.993	0.035	0.831
Secondary	1.178	0.024	0.000
Higher secondary	1.225	0.064	0.000
Tertiary	1.308	0.071	0.000
Religion			
Hindu	1.021	0.016	0.193
Muslim	0.518	0.089	0.000
Christian	0.763	0.124	0.057
Other religion	1.435	0.140	0.002
Caste			
Scheduled Caste (SC)	0.751	0.071	0.000
Scheduled Tribe (ST)	0.853	0.075	0.051
General/forward caste	1.078	0.021	0.000
Have daughter 6+	1.22	0.012	0.000
More than 2 kids 6+	1.711	0.057	0.000

*Notes: This table reports the characteristic distribution of the compliers. The sample consists of mothers from rural India, aged 15-49 years with at least one child aged 6+ years and no child over 18 years. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

2.6.5 Fathers' labour supply

In this section, I examine the effect of the presence of pre-school children aged 0 to 5 years on fathers' labour supply. I analyse the sample of husbands of women aged 15-49 years with at least one child aged 6+ and no child above 18 years. I use not having a son aged 6+ years (noson6plus) as an instrument for the presence of children aged 0 to 5 years (kid0_5), conditioning on the number of children aged 6+ years the parents already have. The results are reported in table A2.9 of the appendix. As expected, fathers' labour participation is unaffected by the presence of children aged 0 to 5 years suggesting that fertility is an important contributor to the gender gap in the labour market. This also reassures that instrument is not capturing any spurious effects.

2.6.6 Heterogeneity in the effect of fertility on labour supply

In this section, I examine whether the effect of fertility on mothers' labour-force participation may be sensitive to or driven by certain sub-populations in the sample. It is helpful from a policy perspective to identify the sub-population of mothers with the highest response to fertility on their labour force participation so that targeted policies can be implemented. Table 2.10 reports the IV estimates from the heterogeneity analysis.

Firstly, I carry out the heterogeneity analysis of the effect of fertility on mothers' labour supply by mothers' education level. For this analysis, the sample is divided into two groups based on the median education level: no education (Years of education=0) and some education level (Years of education>0). The results indicate that the effect of fertility on mothers' labour supply is negative and statistically significant for women with no education, but insignificant for women with at least some education. According to the Indian Census, the female literacy rate was as low as 21.70% and 30%, respectively in 1981 and 1991. Almost 65% of women in my sample have no education.

Secondly, I explore whether the effect of fertility on mothers' labour-force participation is likely to vary with the wealth of the family. For this, the sample is divided into wealth quartiles. The IV estimates show that the negative effect of fertility on mothers' labour supply remains insignificant for mothers belonging to the bottom quartile. It is however highly negative and significant for mothers belonging to the highest income quartile. For these mothers, the presence of a young child 0 to 5 years, reduces labour supply by 19.2%, statistically significant at the 1% level. This seems reasonable as mothers belonging to affluent families have a lesser need to work compared to mothers belonging to lower-income families, to support their families financially. Also, there is evidence from developed countries that children benefit from being raised by mothers themselves, as mothers simply know better about their children and thus, women who can afford to be at home are willing to raise their children by themselves and invest their time towards the children's care, education and development. The incentive to work, if any, is worsened by cultural setbacks, gender stereotypes, unavailability of female-friendly formal sector jobs in rural India, absence of child-care facilities at work, inflexible working conditions, and gender wage differentials.

Table 2.10: Heterogeneity Analysis

Variables	Observations	Mean of work_now	IV estimates
		Education	
Illiterate (No education)	33,026	0.469	-0.150*** (0.053)
Literate (Some education)	18,092	0.308	-0.043 (0.039)
		Per-capita wealth quartiles	
Lowest Quartile	12,780	0.394	-0.105 (0.071)
Second Quartile	12,779	0.414	-0.101* (0.058)
Third Quartile	12,780	0.429	-0.030 (0.060)
Highest Quartile	12,779	0.413	-0.192*** (0.073)
		Mother-in-law co-resides	
No	49,203	0.412	-0.102*** (0.033)
Yes	1,915	0.423	-0.097 (0.225)
		Social group	
Non SC/ST Hindus	28,092	0.396	-0.085** (0.039)
SC/ST Hindus	12,330	0.524	-0.107 (0.083)
Muslims	5,119	0.242	-0.399** (0.181)
Other religion	5,497	0.407	-0.018 (0.088)
Controls			Yes
State fixed effects			Yes

*Notes: This table reports the results obtained from heterogeneity analysis by mothers' age; wealth quartiles; education; co-residence with mother-in-law; and social groups. The sample consists of mothers aged 15-49 years with at least one child aged 6+ years and no children over 18 years. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

Thirdly, I also carry out the heterogeneity analysis by co-residence with the mother-in-law. The estimates indicate that fertility negatively affects the labour supply of mothers living without a mother-in-law. The presence of young children reduces the labour supply of these mothers by 10.2%, which is statistically significant at the 1% level. While the effect is insignificant but imprecisely estimated for mothers living with their mother-in-law as the number of observations is few. Residing in extended families is a major source of informal childcare in India and helps mothers with the sharing of childcare responsibilities. So, one would expect the effect of the presence of younger children on mothers' labour supply to be lower for mothers co-residing with their mother-in-law.

Lastly, I check for heterogeneity by social groups delineated by religion and caste. Upper-caste Hindu women significantly lower their participation due to the presence of younger children because of higher cultural restrictions (Klasen & Pieters, 2015). Upper-caste Hindus and Muslims have been reported to have a more traditional view of women's role and higher social stigma attached to working women, especially in low-end skilled jobs. For Muslims, the presence of younger children reduces mothers' labour supply by 40%. For SC/ST Hindus, the effect is insignificant.

2.7 Concluding Remarks

To the best of my knowledge, this paper is the first to estimate the causal effect of having a pre-school child aged 0 to 5 years on mothers' labour force participation in rural India. Fertility and labour force participation decisions of the mother are jointly and simultaneously determined, thus, generally resulting in biased OLS estimates. This paper uses the instrumental variable technique to deal with this issue of endogeneity. Given a strong son preference in India, parents tend to keep on having additional children until they have at least one son. "Not having at least one male child aged 6+ in the household" is used as an instrument for the presence of children aged 0 to 5 years. Since the sex of the children is plausibly random, the instrument serves as an exogenous source of variation in fertility decisions.

The results from the first-stage specification suggest that not having a boy aged 6+ years makes the mother 32.4% more likely to have another child aged 0 to 5 years. The IV estimates that the presence of young children aged 0 to 5 years reduces the participation of mothers by 9.9%, which is statistically significant at the 5% level. This paper also shows that the LATE estimate, which captures the treatment effect for compliers, is generalizable to the whole population of interest, i.e. compliers, always-takers, and never-takers.

Lastly, the heterogeneity analysis shows that the negative effect of the presence of children aged 0 to 5 years on mothers' labour supply is driven by mothers with no education, mothers from wealthy families, upper-caste Hindus (Non-SC/ST) and Muslims. These results reflect two channels affecting the labour supply of mothers with young children. Firstly, culturally or religiously determined restrictions on women mobility and work, which are generally higher for upper Hindu castes and Muslims than lower caste Hindus, result in mothers' withdrawal from the labour market. These women are subjected to higher patriarchal controls and have higher restrictions on the type of work considered acceptable for women (Klasen & Pieters, 2015; Sorsa, 2015).

Secondly, mothers' labour supply in rural India seems to be driven by financial necessity (M. B. Das & Desai, 2003). Mothers belonging to wealthy families, who can afford to stay at home, withdraw from the labour market in response to the presence of younger children and tend to stay at home to take care of children. Lower returns to the labour market further discourage these women to work. Whereas mothers from poor households have the financial necessity to work and respond less to the presence of children. For example, lower castes, in addition to having lesser social and cultural restrictions, are generally socioeconomically disadvantaged and therefore, respond less to the presence of younger children. Furthermore, reservation of 15% and 7.5% seats to Scheduled castes and Schedules Tribes, respectively, in public jobs provided by the Government of India to address labour market discrimination against socially and economically backward castes contributes to higher participation among women in these social groups by providing them access to a captive pool of regular salaried jobs (Chapman & Mishra, 2019).

The findings in this paper might have important implications in terms of public policy. Policies introducing female-friendly, high-skilled and white-collar job opportunities with good and equal remunerations are needed to incentivize mothers in rural India to work outside the home. Due to the unavailability of suitable and culturally acceptable jobs and a good pay scale in the job market, mothers tend to stay out of the labour market unless they have a compelling need to work to financially support the family. Mothers from high-income families prefer to stay at home and manage domestic tasks, such as schooling children and invest time in their development.

These mothers understand that their support to children is better for their development than what they could buy as a replacement with the money from work. With higher earnings, social norms shall become less restrictive (Lahoti & Swaminathan, 2013) and mothers shall also be able to substitute their decreased time investment with better and more productive alternatives and compensate for the negative effect of reduced time investment on children's development (Agostinelli & Sorrenti, 2021; Nicoletti et al., 2020).

Additionally, the availability of quality alternative sources of childcare is equally crucial. In India, the lack of good formal childcare acts as a major deterrent to mothers' labour force participation. Investment in the quality and quantity of formal childcare facilities, schools and daycare facilities, including direct provision of public pre-school and day-care nurseries, is required as a substitute for informal childcare facilities to help and incentivize mothers who are out of labour force due to disproportionate childcare responsibilities.

Finally, in addition to female-friendly jobs and quality formal childcare, there is a need to redefine the existing social norms that restrict women's economic participation and discourage gender stereotypes that lead to occupational segregation. This can be attained through information campaigns promoting gender equality and de-feminization of unpaid work and childcare responsibilities in the household.

2.8 Appendix

Table A2.1: Main Specification (Sample- mothers aged <=49 years with at least one child aged 6+ years and no child above 18 years)

VARIABLES	OLS	First Stage	Reduced form	Full sample
kid0_5	-0.039***			-0.102***
	(0.005)			(0.032)
No son 6+ years (noson6plus)		0.185***	-0.019***	
		(0.006)	(0.006)	
No daughter 6+ years (ndaught6plus)	-0.000	0.034***	-0.008	-0.004
	(0.005)	(0.006)	(0.006)	(0.005)
No. of children 6+ years (Nkid6plus)	0.006***	-0.031***	0.005**	0.002
	(0.002)	(0.002)	(0.002)	(0.003)
Education (Base- None)				
Education = 1, Primary	-0.101***	-0.042***	-0.100***	-0.104***
	(0.006)	(0.006)	(0.006)	(0.006)
Education = 2, Secondary	-0.148***	-0.058***	-0.146***	-0.151***
	(0.006)	(0.006)	(0.006)	(0.007)
Education = 3, Higher sec	-0.086***	-0.054***	-0.083***	-0.089***
	(0.017)	(0.015)	(0.016)	(0.017)
Education = 4, Tertiary	0.088***	-0.016	0.089***	0.087***
	(0.023)	(0.020)	(0.023)	(0.023)
Husband's education (Base- None)				
Husband's education = 1, Primary	-0.040***	-0.020***	-0.039***	-0.041***
	(0.006)	(0.006)	(0.006)	(0.006)
Husband's education = 2, Secondary	-0.111***	-0.031***	-0.110***	-0.113***
	(0.005)	(0.005)	(0.005)	(0.006)
Husband's education = 3, Higher sec	-0.153***	-0.042***	-0.151***	-0.155***
	(0.009)	(0.009)	(0.009)	(0.009)
Husband's education = 4, Tertiary	-0.161***	-0.069***	-0.159***	-0.166***
	(0.010)	(0.010)	(0.010)	(0.011)
Mother-in-law co-resides	-0.009	0.042***	-0.011	-0.006
	(0.011)	(0.010)	(0.011)	(0.011)
Age	0.006*	-0.033***	0.007*	0.004
	(0.004)	(0.003)	(0.004)	(0.004)
Age squared	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Religion (Base- Hindus)				
Religion = 1, Muslim	-0.138***	0.152***	-0.144***	-0.129***
	(0.007)	(0.007)	(0.007)	(0.008)
Religion = 2, Christian	0.028**	0.037***	0.027**	0.031**
	(0.012)	(0.012)	(0.012)	(0.012)
Religion = 3, Others	-0.010	0.012	-0.010	-0.009
	(0.011)	(0.012)	(0.011)	(0.012)
Caste (Base- SC)				

Caste = 1, ST	0.107***	-0.018**	0.108***	0.106***
	(0.008)	(0.008)	(0.008)	(0.008)
Caste = 2, Others	-0.043***	-0.041***	-0.042***	-0.046***
	(0.006)	(0.006)	(0.006)	(0.006)
Wealth Quintiles				
Second quintile of wealth index	-0.008	0.007	-0.008	-0.008
	(0.007)	(0.007)	(0.007)	(0.007)
Third quintiles of wealth index	-0.005	0.001	-0.005	-0.005
	(0.007)	(0.007)	(0.007)	(0.007)
Fourth quintiles of wealth index	0.004	0.001	0.004	0.004
	(0.007)	(0.006)	(0.007)	(0.007)
Fifth quintiles of wealth index	0.014**	0.006	0.014**	0.014**
	(0.007)	(0.007)	(0.007)	(0.007)
Survey round = 2	0.026***	-0.040***	0.027***	0.023***
	(0.004)	(0.004)	(0.004)	(0.004)
Family size excluding own children	-0.003***	0.001***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.687***	1.423***	0.650***	
	(0.060)	(0.053)	(0.060)	
Observations	51,118	51,118	51,118	51,118
R-squared	0.183	0.234	0.182	0.068
State FE	Yes	Yes	Yes	Yes
F stat:	309.4	425.9	306.5	167.8
Adjusted R-squared	0.182	0.233	0.181	0.0673
Weak identification test (Cragg-Donald Wald F statistic):				1051
DW Hausman test for endogeneity (p-val):				0.0478

*Notes: This table reports the OLS, first-stage, reduced form and 2SLS estimates. The dependent variable of interest is mothers' participation (Work), the endogenous independent variable of interest is- having a kid aged 0 to 5 years (kid0_5) and the instrument is- not having a son aged 6+ years (noson6plus). The sample consists of 7553 mothers from rural India, aged 15-49 years with at least one child aged 6+ years and no child over 18 years. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

Table A2.2: Model Robustness- 2SLS

	(1)	(2)	(3)
	noson6plus #nodaught6plus	noson6plus #religion	Noson6plus #Nkid6plus
kid0_5	-0.0915***	-0.0945***	-0.0138
	(0.0303)	(0.0298)	(0.0301)
Observations	51,118	51,118	51,118
R-squared	0.069	0.069	0.072
State FE	Yes	Yes	Yes
Adjusted R-squared	0.0685	0.0682	0.0707
First-stage F statistic	640.1	318.1	267.2
p-val Hansen J stat	0.378	0.437	0.443

*Notes: This table reports the 2SLS estimates for various models. The first stages are reported in Table A2. The sample consists of mothers from rural India, aged 15-49 years with at least one child aged 6+ years and no child over 18 years. All the specifications include controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

Table A2.3: Alternative definitions of participation variable

	(1)	(2)	(3)
	Works away from home	Works for someone outside the family	Works for money
kid0_5	-0.101***	-0.058**	-0.072**
	(0.0316)	(0.026)	(0.029)
Observations	51,056	51,068	50,574
State FE	0.073	0.064	0.064
Controls	Yes	Yes	Yes
R-squared	0.0716	0.0631	0.0631
First-stage F-stat	1050	1048	1037

*Notes: This table reports the IV estimates for three alternative definitions of mothers' labour force participation. The sample consists of mothers from rural India aged 15-49 years with at least one child aged 6+ years and no child over 18 years. All regressions include socioeconomic controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

Table A2.4: Results including mothers with children aged 18+ years in the analysis: Robustness check

	(1)	(2)	(3)	(4)
VARIABLES	OLS	First stage	Reduced Form	IV
kid0_5	-0.0394***			-0.104***
	(0.00402)			(0.0268)
noson6plus		0.192***	-0.0200***	
		(0.00469)	(0.00515)	
Observations	78,056	78,056	78,056	78,056
R-squared	0.185	0.360	0.184	0.067
State FE	Yes	Yes	Yes	Yes
First-stage F stat		1678		

*Notes: This table reports the estimation results for the sample of mothers aged 15-49 years with at least one child aged 6+ years. The sample also includes mothers with children aged above 18 years. All the specifications include controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

Table A2.5: Robustness check to account for sex-selective abortions

	(1)	(2)	(3)	(4)	(5)
				At most two children 6+	
	One child 6+	One child 6+ & Hindus	Muslims	Below median MFR 0 to 6 years in 1981	First quartile MFR 0 to 6 years in 1981
kid0_5	-0.383*	-0.505**	-0.399**	-0.211***	-0.267***
	(0.227)	(0.254)	(0.181)	(0.061)	(0.103)
Observations	15,047	11,984	5,199	15,411	9,634
R-squared	-0.002	-0.065	-0.112	0.085	0.061
State FE	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	-0.005	-0.069	-0.123	0.083	0.058
First-stage F stat:	30.09	26.25	31.18	327.3	120.5

*Notes: This table reports the estimation results for various subsamples of mothers aged 15-49 years as described in the column heading. All the specifications include controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

Table A2.6: Check for exclusion restriction- potential differential involvement of mothers in the care of sons and daughters

	Mothers sterilized 6 years ago or before						
	First Stage	Reduced Form (Dep var- WORK)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Pooled	Pooled	Nkid6plus=1	Nkid6plus=2	Nkid6plus=3	Nkid6plus=4	Nkid6plus==5+
noson6plus	-0.0004	-0.005	-0.011	-0.031	0.036	0.073	0.038
	(0.0005)	(0.021)	(0.055)	(0.030)	(0.045)	(0.088)	(0.173)
Observations	8,668	8,668	319	2,835	3,604	1,472	438
First-stage F stat	0.082						

	Mothers aged 40+ and sterilized 6 years ago or before					
	First Stage	Reduced Form (Dep var- WORK)				
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Pooled	Pooled	Nkid6plus=1	Nkid6plus=2	Nkid6plus=3	Nkid6plus=4
noson6plus	0.007	-0.019	-0.047	-0.109	0.293	0.814**
	(0.006)	(0.078)	(0.326)	(0.142)	(0.230)	(0.316)
Observations	564	564	44	171	223	90
First-stage F stat	0.557					

*Notes: Table reports the first stage (noson6plus on kid0_5) and reduced form (noson6plus on WORK) results for a sample of mothers who have most likely completed their fertility. All the specifications include controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

A2.7: Oster Test: Checking robustness of estimates to omitted variable bias

	Treatment Effect Estimate		
	Estimated Beta	Oster's Beta	Oster's Delta
First Stage	0.182	0.185	2.596
Reduced Form	-0.0191	-0.0189	987.10

Notes- Oster test results to evaluate the robustness of the first stage and reduced-form estimates to omitted variable bias. The controlled model includes all the control variables used in the main instrumental variable model specification, while, the uncontrolled model only controls for no. of children aged 6+ and the state fixed effects.

A2.8: Effect of the number of children aged 0 to 5 years on mothers' participation decision.

	(1)	(2)	(3)	(4)
VARIABLES	OLS	First Stage	Reduced Form	2SLS
Nkid0_5	-0.028***			-0.056**
	(0.003)			(0.018)
noson6plus		0.338***	-0.019**	
		(0.010)	(0.006)	
Observations	51,118	51,118	51,118	51,118
R-squared	0.184	0.234	0.182	0.071
State FE	Yes	Yes	Yes	Yes
First-stage F statistic		1217.05		

*Notes: This table reports the OLS, first-stage, reduced form and 2SLS estimates of the effect of the number of children aged 0 to 5 (Nkid0_5) on mothers participation (WKANY). The instrument used is noson6plus. The sample consists of 7553 mothers aged 15-49 years with at least one child aged 6+ years and no child over 18 years. All the specifications include controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis*

A2.9: Fathers' labour supply

	(1)	(2)	(3)	(4)
	Fathers' labour force participation			
VARIABLES	OLS	FS	RF	IV
kid0_5	0.002**			0.001
	(0.001)			(0.006)
noson6plus		0.186	0.0001	
		(0.006)	(0.001)	
Observations	51,019	51,019	51,019	51,019
R-squared	0.011	0.235	0.011	0.009
State FE	Yes	Yes	Yes	Yes
First-stage F statistic		1016.45		

*Notes: This table reports the OLS, first-stage, reduced form and 2SLS estimates. The dependent variable of interest is fathers' participation decision and fathers' hours worked per year, the endogenous independent variable of interest is- having a kid aged 0 to 5 years (kid0_5) and the instrument is- not having a son aged 6+ years (noson6plus). The sample consists of 7051 husbands of women aged 15-49 years with at least one child aged 6+ years and no child over 18 years. All the specifications include controls. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%. Robust standard errors are in parenthesis.*

A2.10: Tolerating defiance

The assumption about monotonicity or absence of defiers is required for the IV estimate to identify the LATE for the compliers. Otherwise, IV estimate is the weighted difference between the effect of the treatment among compliers and defiers. However, recent literature, including Chaisemartin (2017) show that the 2SLS still estimates a LATE if the monotonicity condition is replaced by a weaker condition, which allows the presence of some defiers. Although, given the ubiquity of son-preference in the Indian context, the monotonicity assumption seems veristic. However, in this paper, following Chaisemartin (2017), I comment on the number of defiers that can be tolerated and the LATE for defiers, for the IV estimate to identify the LATE for compliers.

1. Ratio of compliers to defiers should be at least 1.85 to identify the LATE for a subset of compliers called surviving-compliers. That is, for each defier in the population (mothers who are girl-preferring), there should be at least two compliers (mothers who are son-preferring). This seems reasonable in the Indian context given the prevalence of the son-preference.

2. The absolute difference between LATE for compliers and defiers should be less than or equal to 4.7% for LATE to be identified which is almost 46% of the Wald estimate. So, the LATE for defiers must lie in the range of 5.53% and 14.9%.

Chapter 3:

Prenatal Sex Detection Technology and Mothers' Labour Supply in India†

3.1 Introduction

Son preference in India has led to poor socioeconomic outcomes for daughters, including female infanticide, excess mortality, and health neglect (Sen, 1992). Male biased sex ratios have been observed throughout India. Male to female sex ratios at birth have risen sharply since the 1981 census. This increase in the last decades has been attributed to the availability of prenatal sex detection technology (henceforth PSDT). The resulting biased sex ratio is concerning because it has implications on violence against women, marriage market imbalance, prostitution, sexually transmitted diseases (STDs), among others (Amaral & Bhalotra, 2017; Arouri et al., 2019; Drèze & Khera, 2000; Ebenstein & Sharygin, 2009; Edlund, 1999; Edlund et al., 2007).

Anukriti et al. (2021) and Hu & Schlosser (2015) study the effects of PSDT on girls' outcomes in India and show that it led to a reduction in their neonatal mortality and post-neonatal mortality rates, and improved parental investment in vaccination and breastfeeding. However, little is known about the effects of PSDT on mothers' outcomes. We contribute to this literature by investigating the impact of this technology on mothers' labour supply and exploring the underlying channels linking PSDT to mothers' labour supply, including changes in fertility and investment in firstborn daughters.

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† Co-authored with Marco Bertoni and Guglielmo Weber.

Given ubiquitous son preference in India, women experience intense societal and familial pressure to produce a son, and failure to do so often carries the threat and consequences of violence or abandonment in their marriage (Asia et al., 2003; Nanda et al., 2013). In societies in which son preference is highly prevalent, not having a son influences the status and well-being of women in numerous ways, including distressed relationship, lack of support, and/or hostility from husbands and in-laws (Rodrigues et al., 2003; Sabarwal et al., 2012). Thus, women often engage in son-biased fertility stopping behaviour, wherein they continue childbearing till they achieve the desired number of sons. This results in higher total fertility and the birth of unwanted daughters, which has a detrimental impact on both women's and girls' health and wellbeing.

Economic pressures and women's rising educational status have led to a desire for smaller families. National family planning policies have also encouraged smaller families to achieve population stabilization, promote reproductive health, and reduce maternal and infant mortality. The advent of prenatal diagnostic technology since the mid-eighties has made it easier for women to identify the sex of the children before their birth, giving them an option to attain the desired family size and sex composition of children without having to undergo repeated pregnancies. Consequently, sex ratios at birth have rapidly become unbalanced over time from 964 girls born for every 1000 boys in 1971 to 927 girls in 2001.

Ultrasound scanners were first introduced in the 1980s with the onset of a period of economic liberalization and became accessible to the general population in the mid-1980s. In the mid-1990s, large scale domestic production of ultrasound scanners was initiated. The low cost and the non-invasive nature of ultrasound scans led to their widespread use for fetal sex determination, resulting in a staggering rise in sex-selective abortion, equivalent to 6 percent of potential female births during 1995-2005 (Bhalotra and Cochrane, 2010).

There are several reasons why the introduction to PSDT could have had consequences on mothers' labour supply. First, prior to PSDT availability parents often engaged in son-preferring fertility stopping behaviour to achieve their desired number of sons. This resulted in continued childbearing and repeated pregnancies. In addition, the birth of a girl often caused parents to exceed their intended fertility (Jayachandran & Pande, 2017). Both channels increase the total number of mouths to feed in the family and impose pressing financial needs for the mothers to work. Second, daughters often represent a substantial economic burden in places where parents provide a dowry. Thus, the birth of a daughter means expected dowry payment in the future, which again raises the necessity for mothers to work (Anukriti et al., 2017; Browning & Subramaniam, 1994). Third, the widespread preferences for sons lead Indian mothers to invest more time and resources in sons than daughters. For example, Mutharayappa et al. (1997) provide evidence of longer breastfeeding for male than female babies. Thus, mothers with sons often work less as compared to mothers with daughters (Pabilonia & Ward-Batts, 2007). By leading to a higher male-to-female birth rate, prenatal sex detection shall make these considerations even more relevant.

Nevertheless, the increased scarcity of girls that followed the introduction of PSDT could have changed girls' value in labour and marriage markets. Consistently, the literature has found that, subsequent to the availability of prenatal sex selection, there were improvements in postnatal investment in girls such as improved breastfeeding and immunization (Anukriti et al., 2021; Hu & Schlosser, 2015). Since ultrasound technology allows families to adjust the gender of future children, mothers may increase time investment in existing girls, which would lower differences in labour supply of mothers with daughters relative to labour supply of mothers with sons.[31]

We estimate the effect of PSDT on mothers' labour supply using survey data from the three rounds of the National Family Health Survey, conducted in 1992/93, 1998/99, 2005/06. The data contains the complete fertility history of women, desired fertility and sex composition of children, their work status, and various other socioeconomic variables.

We identify the effect of PSDT-induced sex selection on mothers' labour supply with a triple-differences (DDD) approach. We compare the labour supply of mothers of firstborn sons vs. daughters, before vs. after the introduction of PSDT, in local areas with high vs. low son preference. First, we use 1995 as a break point in the supply of ultrasound scanners, following the acceleration of economic reforms and domestic production of scanners. Second, the sex of the firstborn child provides quasi-random family level variation in the incentive to conduct sex selection. In fact, previous research shows that the sex of the firstborn child is as good as random and that parents with firstborn daughters are more likely to sex-select relative to parents with firstborn sons (see for ex. Almond & Edlund, 2008; Bhalotra & Cochrane, 2010; Edlund, 1999; Kugler & Kumar, 2017).[32] Third, we compare across Indian local areas with high and low son preference, measured by the male to female ratio of children aged 0-6 by state and rural/urban areas, as observed in the 1981

[31] Rose (1999) using the data on rainfall shocks finds that favourable income shocks disproportionately benefit girls relative to boys. We hypothesize that fewer "unwanted" daughters acts as a positive income shock for the families.

[32] Anukriti et al. (2021) and Bhalotra & Cochrane (2010) use a similar approach to study the effect of PSDT on sex ratio at birth.

Indian Census.[33] This measure reflects son preference in so far as unwanted daughters are more likely to die in their early childhood due to lack of care or insufficient nutrition.

Taking differences across local regions improves our ability to control for confounding factors that could bias a simple difference-in-differences design comparing the labour supply of mothers with firstborn sons vs. daughters, before vs. after the introduction of PSDT. For example, the wave of liberalizations happening in India since the 1980s also resulted in improved educational attainment, which could have led to changes in son preferences and influenced the evolution of mothers' labour supply differently by gender of their firstborn. Our identifying assumption is that the difference-in-differences estimate obtained in low son-preference states captures the secular trends in maternal labour supply by gender of firstborn that would have been observed in high son-preference states in the absence of PSDT-induced sex selection. Under this assumption, the triple-differences estimator identifies the causal effect of PSDT.

Our results show that prenatal sex detection technology led to a significant reduction in mothers' labour supply. We then turn to explore various channels that might link prenatal sex selection and mothers' labour supply by analysing whether prenatal sex selection is associated with changes in fertility behaviour, investment in girls, mortality rates among girls, and change in preference towards sons.

We show that the wider availability of sex selection technology changed the fertility behaviour of mothers. Results from heterogeneity analysis suggest that the observed reduction in mothers' labour supply subsequent to wider availability of PSDT is driven by mothers with no education, no husband's education, belonging to low wealth and rural families, and Hindus. In terms of mechanisms, we observe a substitution of daughters with sons. Consistent with the evidence of lower labour supply for mothers of boys, this shall have contributed to the fall in mothers' labour supply. We do not find any evidence of change in reported preference towards sons, suggesting that the DDD estimates are not driven by changes in son preference over time. Instead, we show that PSDT led parents to invest more in their firstborn girls. We observe a reduction in daughters' mortality rates, stunting, and illness episodes in the two weeks prior to the survey, and improved

[33] This measure shall capture the prevalence of son preference *before* the introduction of ultrasound scanners in mid-1980s. Prior to the availability of prenatal sex detection technology, families exercised son-preference through discrimination against girls in infancy and during childhood leading to excess girl mortality in early childhood (Rose, 1999; Sen, 1992). We do not use MFR from post PSDT period as it could be endogenous to the availability of ultrasound machines in the local areas.

immunization. These patterns suggest that PSDT increased mothers' time investment in firstborn girls, lowering the gap in labour supply of mothers with firstborn girls vs. boys.

The rest of the paper is organized as follows. In section two, we provide a brief background and institutional framework. Section three presents our data and section four describes our empirical methodology. Section six presents the estimation results and section seven concludes.

3.2 Background and Institutional Framework

India is characterized by a high prevalence of son preference. Prior research has identified some important social, religious and economic reasons that may potentially contribute to the presence of son preference, such as the financial and labour contributions of sons to the family, their perpetuation of the family name, dowry practise, the entitlement of sons to perform certain religious ceremonies, and sons being the source of old-age support (Arnold et al., 1998, 2002; Mutharayappa et al., 1997; Vlassoff, 1990).[34]

Indian families express a strong preference for having at least one son, and often two, among their children (Mutharayappa, Choe, Arnold, & Roy, 1997). In order to achieve their ideal number of sons, parents often practice son-preferring Differential Stopping Behaviour (DSB) and continue having children until the ideal number of sons is achieved.

The biologically normal population sex ratio (sons to daughters) at birth ranges from 1.03 to 1.07. Sex ratios at birth above 1.07 suggest that pre-birth interventions are reducing the likelihood of a female birth. Since 1981 India has experienced a sharp rise in the male to female ratio (MFR) at birth. In 1971 there were 964 girls for every 1000 boys at birth, which is in the "normal" range. The number of girls diminished at an increasing rate over the next three decades, reaching 927 in 2001 (Bhalotra & Cochrane, 2010). This fall in the number of girls for every 1000 boys at birth since 1981 has been attributed to the legalization of abortion along with the increased access to prenatal sex detection technology, which enabled women to undergo the abortion of unwanted female children. According to Bhalotra & Cochrane (2010), in the post-ultrasound regime (1995-2005) half a million girls per annum were selectively aborted in India.

[34] Past studies have also documented adverse consequences of son preference, such as excess female child mortality, neglect of female health and nutrition, especially-but not exclusively-during childhood, including access to preventive care, feeding, and immunization (Arnold et al., 1998, 2002; Clark, 2000; Gupta, 2020; Mutharayappa et al., 1997; Sabarwal, 2008; Sen, 1992)

Abortion was legalized in India in 1971, with the passage of the Medical Termination of Pregnancy (MTP) 1971 Act, effective in most states in 1972 (Stillman et al., 2014, Arnold et al., 2002). The act was passed to regulate and ensure access to safe abortion for women and reduce maternal death due to unsafe abortions. Sex determination of the foetus in India first became possible with the advent of amniocentesis in the 1970s. However, due to high direct costs and the invasiveness of amniocentesis, its widespread usage was limited (Anukriti et al., 2021). According to Grover & Vijayvergiya (2006), before the early 1980s, sex determination was only done to study sex-linked disorders and for DNA testing in health research institutes.

Fetal sex selection only really became feasible after 1980, with the onset of liberalizations and the arrival of ultrasound scanners (Bhalotra & Cochrane, 2010). Demand for ultrasound scans proliferated as a result of the technology being non-invasive and of its wide affordability – at about $10-$20 for a scan (Arnold et al., 2002). By the mid-1990s, import tariffs for medical devices were largely reduced, and large-scale local production of ultrasound scanners was initiated[35]. According to government data, the number of ultrasound machines manufactured in India increased 33 times between 1988 and 2003 with especially marked increases after 1994 (Bhalotra & Cochrane, 2010; George, 2006; Grover & Vijayvergiya, 2006).

Anukriti et al. (2021) show that the evolution of ultrasound use closely tracks the one of ultrasound machines availability, and so does the trend in the officially reported number of abortions, which displays a steep acceleration after 1995. Using data from NFHS rounds 2 and 3 and data on the officially reported number of abortions, they show a positive correlation between the fraction of births with ultrasound use and the number of abortions by state and year.

Access to abortion services was not difficult in India, even in the remotest areas of the country (Duggal, 2005) and most abortions were practised in unofficial and non-regulated facilities. The cost of an abortion varied by region, type of facility, method and gestation period ranging from US$4.5 to US$16.5 (Arnold et al., 2002; Hu & Schlosser, 2015; Ravindran, 2002; Sundar, 2003).

Given the rising male to female ratio, sex selection has become the dominant concern amongst women's and human rights organizations. In 1994, the Prenatal Sex Diagnostic Techniques (Regulation and Prevention of Misuse) (PNDT) Act was passed. The Act became operational in 1996

[35] The number of imported ultrasound scanners, as reported by Mahal et al.(2006), were 742 during 1991-94, 1135 during 1994-97, 1737 during 1997-2000, and 4733 during 2000-03. And the number of domestically produced ultrasound machines were 1314 during 1988–91, 5651 during 1992–95, 11290 during 1996–99, and 19581 during 2000–03 (George, 2006).

and made it illegal to use prenatal sex-diagnostic techniques to reveal the sex of a foetus. However, the act was difficult to enforce, hardly any cases of violation were reported from the states and no one was punished (Visaria, 2005). The 2001 Census revealed continuing deterioration in the sex ratio. Following which public interest litigation was filed in the Supreme Court by some non-governmental organizations. This led to the amendment and strengthening of the PNDT Act in 2002, incorporating a ban on advertising prenatal sex determination and increased penalties for violations. There have been mixed evidence on whether these regulations made any difference (Nandi & Deolalikar, 2013; Visaria, 2005).

The literature has also documented heterogeneity in the practice of sex-selection across states, social groups and economic groups (Almond & Edlund, 2008; Anukriti et al., 2021; Arnold et al., 2002; Bhalotra & Cochrane, 2010; Hu & Schlosser, 2015; Mutharayappa et al., 1997; Sabarwal, 2008). Deficits of girls among the second and third birth order children have been found to be greater among educated women and economically well-off families. Son preference in terms of the stated ideal male to female ratio is observed throughout India, but it is particularly high for northern states as well as Uttar Pradesh, Bihar and Gujarat.

3.3 Data and Descriptive Statistics

We use nationally representative microdata from the National Family Health Survey (NFHS). Specifically, we use the first three survey rounds of NFHS conducted in 1992-93, 1998-99, and 2005-06. Each NFHS survey covered 99% of India’s population residing in its 26 states and included approximately 89 thousand eligible women aged 15-49 years. The survey includes detailed information on birth history, work status of mothers, desired fertility and sex composition of children, and the demographic and socioeconomic background of the household.

Using non-parametric plots and flexible parametric specifications, Bhalotra and Cochrane (2010) identify 1985 as a break-point in the trend of the average sex ratio at birth. They identify 1995 as the second break point in ultrasound availability based on the evidence of sharp increases in the supply of ultrasound scanners following the acceleration of economic reform in the early and mid-90s and initiation of domestic production (Anukriti et al., 2021). Due to the unavailability of data before 1985, we use 1995 as the break point in widespread availability of ultrasound and exploit increasing penetration of ultrasound during post-ultrasound years to estimate if increased availability of prenatal sex detection affected mothers’ labour supply decision.

For the pre-PSDT period, we select the sample of mothers from NFHS round 1 who gave their first birth between 1991-93. For the post-PSDT period, we analogously select the sample of mothers from NFHS round 2 who gave their first birth between 1997-99. We use these limited time intervals to enhance the comparability of the samples before and after 1995 and to reduce the share of mothers with multiple births, so as to prevent the confounding effect of total fertility on mothers' labour supply. With these restrictions, we limit the share of mothers with multiple births to 5% of the sample.

We report descriptive statistics for all the variables used in the analysis in Table 3.1. The data is well balanced with 49.5% observations belonging to the pre-1995 sample and 50.5% to the post-1995 one. Around 22% of mothers in the sample are working and 48.5% have firstborn daughters. The average age of mothers in the sample is 21 years and the age at first marriage and first birth are very low, at 18 and 20 years, respectively. Most mothers (about 73.4%) in the sample reside in rural areas. About 45% of mothers have no education and 25% of fathers have no education. About 81% of women in the sample are Hindus.

To measure differences in proclivity to commit sex-selection at the local level, we use data from the 1981 Indian Census and construct the male-to-female ratio of children aged 0 to 6 years in each Indian state, separately for residents in urban and rural areas. This measure shall capture the prevalence of son preference *before* the introduction of ultrasound scanners. We use the MFR for children aged 0 to 6 years instead of the MFR at birth because sex-selective abortion was not feasible prior to the availability of PSDT, and families exercised son preference through discrimination against girls in infancy and during childhood. Hence, the MFR of children between 0 to 6 years shall capture both neonatal and post-neonatal efforts to carry out sex selection. As a robustness check, we also use two alternative measures of local preference for sons:[36]

a) the growth in the MFR of children aged 0 to 6 years between the 1981 and 1991 Indian censuses at the state level. This serves as an indicator for the spread/ availability of PSDT in the first wave of liberalization.

[36] MFR data is unavailable for Assam in the 1981 Indian census and for Jammu & Kashmir in the 1991 census. Thus, there are 506 missing observations for MFR in 1981 and 1056 missing observations for growth in MFR between 1981-91.

b) the mean of the ideal sex ratio reported by mothers in the first round of the NFHS survey conducted in 1992-93 in each Indian state, separately for residents in urban and rural areas. [37]

We standardize all three variables so that they have zero mean and unit standard deviation.[38]

Table 3.1 Descriptive statistics

	Mean	Std. Dev.
Post 1995	0.503	0.005
Work now	0.222	0.004
Firstborn girl	0.485	0.005
Age	20.894	0.035
Age at first marriage	17.783	0.033
Age at first birth	20.355	0.035
Marital status (Married)	0.987	0.001
Wealth index	-0.004	0.010
Own education		
No education	0.454	0.005
Lower Primary (0-4)	0.072	0.003
Upper Primary (5-7)	0.151	0.004
Primary Completed (8-9)	0.112	0.003
Secondary(10-11)	0.101	0.003
Senior secondary(12 and above)	0.110	0.003
Husband's education		
No education	0.245	0.005
Lower Primary (0-4)	0.073	0.003
Upper Primary (5-7)	0.157	0.004
Primary Completed (8-9)	0.155	0.004
Secondary(10-11)	0.171	0.004
Senior secondary(12 and above)	0.199	0.004
Religion		
Hindu	0.816	0.004
Muslim	0.119	0.003
Christian	0.028	0.001
Other religion	0.036	0.002
Urban	0.271	0.004
Total births	1.067	0.003
Local MFR for 0 to 6 years in 1981	1.043	0.000
Growth in state MFR (1981-91)	0.061	0.000
Local ideal sex ratio	1.438	0.002

Notes: The number of observations is 13412. Data are weighted using population-level weights.

[37] NFHS survey asks mothers about the ideal number of sons, ideal number of daughters and ideal number of children of either gender. We construct the Ideal MFR as: $ideal_{boys} + (0.5 * ideal_{either})/ideal_{girls} + (0.5 * ideal_{either})$. NFHS round 1 did not cover Sikkim and thus, the ideal MFR is not available for this state.

[38] Standardization of these variables is carried out in the local/state level sample.

3.4 Methodology

3.4.1 Empirical approach

The ideal experiment to estimate the causal effect of prenatal sex detection technology on mothers' labour supply would be based on random assignment of access to prenatal sex detection technology across individual (or groups of) women. Unfortunately, to the best of our knowledge, such an experiment has never been carried out in India. In addition, we do not observe whether mothers practice sex-selective abortion. Therefore, our empirical strategy is based on variation in the *proclivity* to use sex detection technology.

We use a triple-differences approach and combine longitudinal variation in the supply of ultrasound technology in India with cross-sectional variability in incentives and preferences to commit sex selection at the family level - captured by the gender of firstborn child –and at the local level – as proxied by the 1981 MFR for ages 0 to 6 years.

We illustrate our triple-differences strategy as follows. Since PSDT was introduced throughout India at the same time, the comparison of maternal labour supply before and after the 1995 break in its introduction would not be informative about a causal effect because of confounding macroeconomic shocks. As a result, we could exploit cross-sectional variation in the likelihood of engaging in sex selection across mothers with a firstborn boy vs. girl by comparing their labour supply before and after 1995, as in a standard difference-in-differences (DiD) approach.

To motivate this approach, in Table 3.2 we provide evidence that mothers of firstborn girls are more likely to engage in sex selection than mothers with firstborn boys after the introduction of PSDT. The table reports the difference in the likelihood of having a boy at the second birth between mothers of firstborn girls vis-à-vis boys. This is estimated using a linear probability model and including controls for mother's age, mother's education, mother's age at first birth, indicators for mother's religion, father's education, wealth and rural/urban status. Observations are weighted using national-level weights and standard errors are clustered at the state level. Column 1 is for children born between 1985 and 1994 (pre-PSDT) and column 2 is for children born from 1995 onwards (post-PSDT).[39] As seen in column 1, the probability of a male birth during the pre-PSDT period did not vary significantly depending on the sex of the firstborn. In contrast, column 2 shows

[39] Results are comparable both qualitatively and quantitatively when we restrict our sample to children born in 1991/94 and 1995/99.

that during the post-PSDT period this probability was significantly higher for households with firstborn girls.

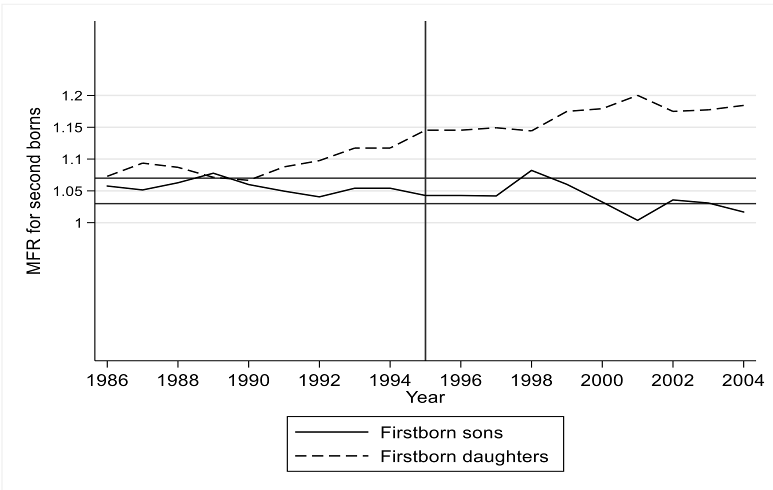
This finding is further corroborated by Figure 3.1, where we plot the 3-year moving average of the male to female ratio for second-born between 1980-2005 by the gender of firstborns[40]. We see an increase in the difference in MFR for second birth order between firstborn girls and firstborn boys after PSDT became widely available, in the mid-1990s.

Table 3.2: Differential probability of having a boy at the second birth by sex of the firstborn child

Dependent variable: Boy at second birth	(1) Born in 1985/94	(2) Born in 1995/04
Firstborn girl	0.003	0.029***
	(0.005)	(0.00945)
Controls	Yes	Yes
Observations	78,570	44,043

*Notes: Each cell reports the coefficient of firstborn girl in an OLS regression of boy at second birth on firstborn girl and controls for the child's birth year, mother's age, mother's education, mother's age at first birth, indicators for mother's religion, father's education, wealth, rural/urban status and state fixed effects. Observations are weighted using national-level weights. Standard errors clustered at the state level are reported in parenthesis. *: p<0.1, **: p<0.05, ***: p<0.01.*

Figure 3.1: Male-to-Female ratio at second birth by gender of the firstborn



Notes: The figure plots the 3-year moving average of male to female ratio for second borns in different years by gender of firstborns. The two horizontal reference lines denote the normal sex ratio of 1.03 and 1.07. The vertical line denotes the structural break in the availability of ultrasound facility in 1995.

[40] To avoid overlapping of male-to-female ratio for pre- and post-ultrasound periods, we use 3-year moving average of years 1992, 1993 and 1994, for the year 1994 and years 1995, 1996 and 1997 for the year 1995.

The DiD approach sketched so far further requires the assumption that selection into having a firstborn boy vs. girl did not change as PSDT became available. We corroborate this assumption in our data in Table 3.3, where we report differences in means in the demographic characteristics of mothers with a firstborn daughter vs. son, for both the pre-and post-1995 samples. We do not find any statistically significant differences in the means of demographic characteristics like mothers' age, age at marriage, age at first birth, marital status, own education, husband's education, religion, and type of residence. This set of balancing tests supports the assumption that the gender of firstborns is as good as random.

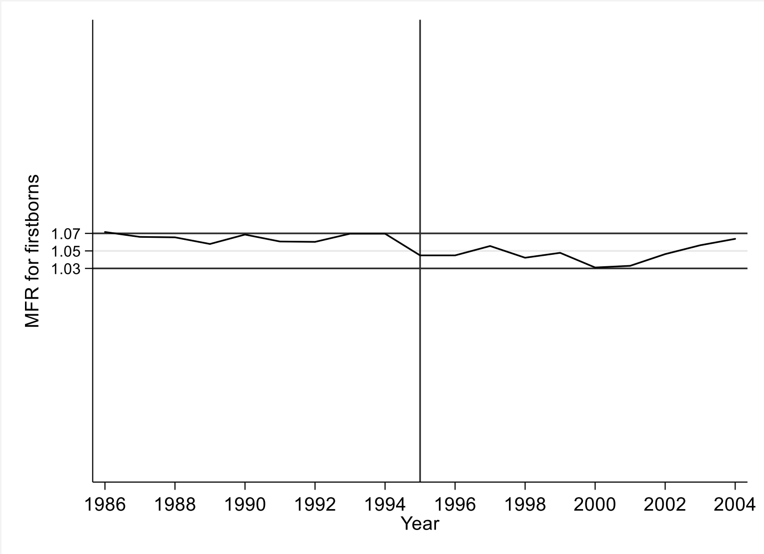
Table 3.3: Balancing tests for firstborn girl

	Pre 1995	**Post 1995**
Age	-0.007	-0.117
Age at first marriage	-0.086	-0.077
Age at first birth	0.000	-0.136
Marital status	-0.001	0.002
Own education		
No education	0.007	-0.001
Lower Primary (0-4)	-0.001	-0.007
Upper Primary (5-7)	-0.015	0.001
Primary Completed (8-9)	0.007	-0.003
Secondary (10-11)	0.009	0.005
Senior secondary (12 and above)	-0.008	0.005
Husband's education		
No education	-0.016	-0.007
Lower Primary (0-4)	0.002	0.012
Upper Primary (5-7)	0.000	-0.004
Primary Completed (8-9)	0.015	-0.001
Secondary (10-11)	0.007	0.007
Senior secondary (12 and above)	-0.008	-0.007
Religion		
Hindus	0.011	0.013
Muslims	-0.009	-0.006
Christians	-0.001	0.002
Others	-0.001	-0.009
Urban resident	-0.002	-0.001
No. of observations	6741	6671

*Notes: Each cell reports the coefficient of firstborn girl in an OLS regression of the characteristic reported in the first column on firstborn girl. *: p<0.1, **: p<0.05, ***: p<0.01.*

In addition, in Figure 3.2 we plot the male to female ratio (MFR) over time for firstborns using the three rounds of NFHS data. The figure shows that the ratio remains close to the normal range of 1.03 to 1.07 and does not become more male-biased after PSDT became available, consistent with the absence of changes in selective abortions among firstborns. This evidence is also consistent with the existing literature, which has shown that the sex of firstborn children is as good as randomly assigned (Almond & Edlund, 2008; Anukriti et al., 2021; Bhalotra & Cochrane, 2010; Kugler & Kumar, 2017). While the sex ratio of the oldest child is found to be biologically normal, that of subsequent children is heavily male-biased, especially when there is no previous son.

Figure 3.2: Male-to-Female ratio at first birth



Notes: The figure plots the 3-year moving average of male to female ratio for firstborns in different years. The two horizontal reference lines denote the normal sex ratio of 1.03 and 1.07. The vertical line denotes the structural break in the availability of ultrasound facility in 1995.

The DiD approach that we have sketched so far would be informative about the causal effect of PSDT on mothers' labour supply under the assumption that there were no underlying trends in maternal labour supply that differ by gender of the firstborn child. However, the economic and cultural liberalization that happened in India since the 1980s led to greater exposure of women to Western media and rising incomes for large sections of the population, which could have affected women's education and their attitude towards rearing firstborn girls vs. boys (and hence their labour supply) irrespective of the availability of PSDT and incentives to sex-select.

To overcome this issue, we further distinguish across Indian local areas with high and low 1981 MFR and assume that the availability of PSDT changed firstborn gender-induced sex selection behaviour more markedly in areas with higher son preference before PSDT became available.

Under this assumption, the difference-in-differences estimate for areas with low son preferences shall mostly capture the changing trends in maternal behaviour by the gender of the firstborn discussed above. If we are also willing to assume that these underlying trends have been comparable across low- and high- son-preference states, then the triple-difference estimator that subtracts the DiD estimate obtained in low son-preference areas from the one in high son-preference ones identifies the causal effect of PSDT on maternal labour supply.

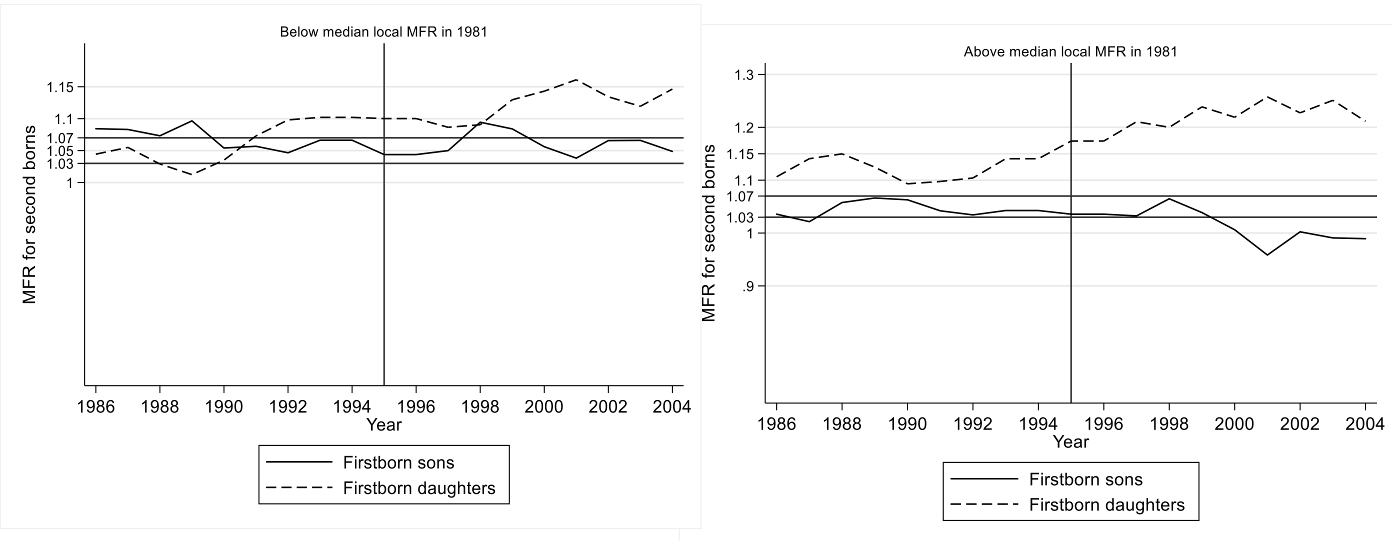
Several pieces of evidence help us substantiate the assumption that firstborn gender-induced sex selection took place more markedly in high son-preferring areas after PSDT became available. First, in Table 3.4 we replicate the analysis of Table 3.2 distinguishing between regions with above and below median son preference. The results confirm that – after the introduction of PSDT – the probability of sex selection at second births conditional on having a firstborn girl vs. boy is much larger in areas with high son preference.

Table 3.4: Differential probability of having a boy at the second birth by sex of the firstborn child and local son preference

Dependent variable: male child at second birth	**(1) Born in 1985/94**	**(2) Born in 1995/04**
Firstborn girl	0.004	0.029***
	(0.005)	(0.005)
Firstborn girl*Son Pref	0.008	0.030***
	(0.006)	(0.004)
Controls	Yes	Yes
Observations	72,760	40,872

Notes: See Table 3.2

Figure 3.3: Male-to-Female ratio at second birth by gender of the firstborn and local son preference



Notes: See Figure 3.1

We confirm this finding, in Figure 3.3, where we plot the MFR at second birth by gender of firstborns for areas with a level of the MFR for ages 0-6 in 1981 above vs. below the median. We observe a rather stable gap in MFR at second birth between families with firstborn girls vs. boys in areas with below-median son preference. For areas with above-median son preference, instead, the MFR at second birth diverges significantly between families with firstborn girls vs boys, and there is a marked increase particularly after 1995 (see for ex. Anukriti et al., 2021; Bhalotra & Cochrane, 2010).[41]

3.4.2 Estimation

We estimate the following regression equation for mother i from state s surveyed in year t:

$$\begin{aligned} \boldsymbol{y_{ist}} = \; & \boldsymbol{\alpha + \beta_1 Post_t + \beta_2 FirstGirl_i + \beta_3 SonPref_{i,s} + \delta_1 Post_t \times FirstGirl_i} \\ & \boldsymbol{+ \delta_2 Post_t \times SonPref_{i,s} + \delta_3 FirstGirl_i \times SonPref_{i,s}} \\ & \boldsymbol{+ \gamma \, Post_t \times FirstGirl_i \times SonPref_{i,s} + X_i + \theta_s + \varepsilon_{ist}} \end{aligned} \qquad \textbf{(3.1)}$$

where, y_{ist} is mothers' labour supply; Post is an indicator of increased penetration of ultrasound scanners- it takes a value 1 for mothers with first child born between 1997-99 and 0 for mothers with firstborns between 1991-93; $FirstGirl_i$ is an indicator for a firstborn girl; and $SonPref_{i,s}$ is an indicator of son preference at the local level. In order to avoid throwing away information, we introduce son preferences linearly. However, we show that our main result is robust to coding it as a dummy variable for areas above or below the median. X_i is a vector of individual characteristics that includes indicators for mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, and residence in an urban area. We include state fixed effects (θ_s) and cluster standard errors by state. Coefficients $\delta_1 \; and \; \delta_2$ capture the effect of having a firstborn girl and higher son preference on mothers' labour supply in the post-ultrasound period. The parameter of interest is γ, which captures the effect of PSDT on mothers' labour supply.

3.5 Estimation Results

3.5.1 Main results on mothers' labour supply

Table 3.5 below reports the estimates for Firstborn girl × Post × Son Preference from a linear probability model with different indicators of son preference at the local level. All specifications include the controls listed in section 3.4. The triple-differences effect is negative and significant for all three alternative measures of son preference. For example, the estimate from column 1 suggests that a 1 SD increase in the MFR in 1981 (indicating prevalent son preference) reduces the labour

[41] We obtain comparable results when we consider the ideal MFR by state or the growth in the MFR by state between 1981 and 1991.

supply of mothers with firstborn girls vs. boys by almost 2.1% after PSDT became more widely available in 1995.

Table 3.5: Effect of PSDT on mothers' labour force participation

Dep. variable: Mothers' labour force participation	**(1)**	**(2)**	**(3)**
Firstborn girl × post × z-local MFR in 1981	-0.021**		
	(0.010)		
Firstborn girl × post × z-growth in state MFR between 1981 and 1991		-0.030***	
		(0.007)	
Firstborn girl × post × z-local ideal MFR			-0.017***
			(0.005)
Observations	13,412	13,412	13,412
R-squared	0.17	0.17	0.17
Mean	0.222	0.222	0.221

*Notes: All the specifications control for mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence and state fixed effects. Standard errors are clustered at the state level and are reported in parenthesis. *: p<0.1, **: p<0.05, ***: p<0.01.*

We have carried out several tests to verify that our main result on labour supply is robust to various potential empirical concerns.

First, in Table A3.1 in the Appendix, we show that our results are robust when we include controls for state-firstborn birth year and state-firstborn gender fixed effects to assess the likelihood of possible biases due to state-specific time trends and state-specific gender differential.

Second, in Table A3.2 in the Appendix, we use mothers' individual (instead of local) ideal son preference as an alternative measure of willingness to sex-select. We find that a 1 SD increase in individual ideal MFR reduces the labour supply of mothers with firstborn girls by almost 7.5% subsequent to the wider availability of prenatal sex detection technology in 1995. The estimate, though larger, still suggests a decline in labour supply in response to the availability of prenatal sex detection technology.

Third, instead of adopting a linear specification for the level of local son preferences, we code it as a binary variable for being above or below the median. The estimate in this specification can be interpreted as the differential effect of the wider availability of ultrasound technology post-1995 on the labour supply of mothers with firstborn girls residing in local areas with above vs. below-median son preference. Results are reported in Table A3.3 of the appendix. Overall, we find that the estimates are qualitatively similar across alternative indicators of son preference.

Fourth, to increase sample size we include in our sample also mothers with first births in 1991 and 1996. Results are reported in Table A3.4 of the appendix and are wholly comparable to our baseline.

3.5.2 Heterogeneity Analysis

We turn to examine whether the effect of the availability of sex detection technology on mothers' labour-force participation is heterogeneous across different sub-populations in the sample. We examine if our results differ by mothers' educational attainment (illiterate versus literate), their husband's educational attainment, household wealth (bottom 50% versus top 50%), religion (Hindu versus others) and rural versus urban residence. The triple-differences estimates are reported in Table 3.6. In each regression, we continue to control for all SES variables, except the one being used to examine heterogeneity.

Table 3.6: Heterogeneous effects of PSDT on mothers' labour force participation

Dep. variable: Mothers' labour force participation	**Post × Firstborn girl × z-local MFR**	
By own education	**Illiterate**	**Literate**
	-0.036**	-0.009
	(0.017)	(0.014)
Observations	5,478	7,934
By husband's education	**Illiterate**	**Literate**
	-0.050***	0.003
	(0.017)	(0.015)
Observations	2,895	7,492
By household Wealth	**Below median**	**Above median**
	-0.042*	0.005
	(0.022)	(0.015)
Observations	6,684	6,728
By religion	**Hindu**	**Non-Hindu**
	-0.031***	-0.001
	(0.010)	(0.019)
Observations	10,350	3,062
By area of residence	**Rural**	**Urban**
	-0.025*	0.006
	(0.012)	(0.013)
Observations	9,237	4,175

Notes: See Table 3.5.

The results indicate that the effect of PSDT mostly dampened the labour supply of illiterate mothers, mothers from poor, rural and Hindu households. This is, in principle, consistent with the hypothesis that labour force participation of poorly educated women and women from poor households is driven by necessity (Klasen & Pieters, 2012). Thus, with fewer unwanted daughters after the availability of ultrasound and decreased need to continue childbearing to attain desired sex composition of children resulting in exceeding of intended fertility, mothers' financial necessity to work reduces.

With respect to the religion of mothers, Hindus have been reported to have a more traditional view of women's role and a higher social stigma attached to working women, especially in low-end skilled jobs. There is also a higher prevalence of son preference among Hindus. Thus, prenatal sex selection has significant effects on the labour supply of Hindus.

3.5.3 Mechanisms

We next explore some of the plausible channels linking prenatal sex detection and mothers labour supply. To this aim, we adopt the same triple-differences strategy used to analyse labour supply, use the main definition of local son preference (the 1981 MFR), and estimate the effect of PSDT on the set of potential mechanisms listed here below. In doing this, we take into account the problem of multiple testing (i.e. false positive outcomes) by using the Romano and Wolf, 2005, stepdown resampling method to adjust p-values within each bundle of outcomes that we consider for each mechanism (when there are multiple ones). We analyse the following mechanisms:

Changes in son preferences. We inspect if there was any change in the relative preference for sons post the availability of sex detection technology to eliminate the concerns that the observed results are driven by changes in son preference over time. We use the following two measures of individual-level son preference:

- a categorical variable on whether the reported ideal MFR is greater than 1
- the standardized reported ideal MFR.

Fertility behaviour. Access to ultrasound technology gave parents the possibility to engage in sex-selective abortions and eliminate any unwanted child, thus, giving them more control over the number as well as the sex composition of children. We investigate whether post availability of PSDT there was a significant change in the number of children, numbers of daughters and number of sons. We use the following two alternative definitions of fertility:

- the number of births within the five years of the first birth, excluding the births after 1994 for the pre-ultrasound period, as these births may have been affected by ultrasound technology.

- the number of births between the age of 14-30 years for all the mothers, eliminating the births after 1994 for the pre-ultrasound period.

Using the above two alternative measures, we construct data for the number of children, the number of sons, and the number of daughters.[42] We also check if there was any effect on the birth spacing between first and second births. We use a sample of first births between 1991 and 1999 using the NFHS 2005 survey.

Investment in firstborn girls.[43] Access to ultrasound technology gave parents the possibility to adjust the gender of future children. The imbalance in sex ratios induced by PSDT may have enhanced the marriage and labour market value of daughters. This may have boosted mothers' willingness to invest in existing daughters, resulting in lower differences in mothers' labour supply in presence of sons versus daughters. Moreover, elder daughters are a potential source of informal childcare for future expected sons. Thus, mothers may improve time investment in firstborn girls, by reducing their labour supply, to improve the quality of childcare provided by the firstborn girls to their younger brothers. We look at investment in firstborn girls from various perspectives:

- anthropometric outcomes measured in terms of stunting, underweight and wasting. We define these indicators on the basis of anthropometric z-scores using the 2006 WHO child growth standards of the same age and gender.[44] Specifically, a child is considered stunted if his/her height-for-age z-score is at least 2 SDs below the reference population. An underweight child has a weight-for-age of at least 2 SDs below the reference population and a wasted child has a weight-for-height at least 2 SDs below.[45]

[42] We use pooled data of retrospective fertility history from the three rounds of the National Family Health Survey (NFHS) conducted in 1992-93, 1998-99 and 2005-06 to construct the two alternative measures of fertility. We restrict the sample to mothers who had their first birth between 1985 and 2005 and use 1995 as the break point in the wider availability of ultrasound technology.

[43] We take the sample of firstborns and regress various investment outcomes on $Girl \times Post \times SonPref$ and other controls described in section 3.4.2.

[44] Note that z-scores are normalised by gender and age to take into account that boys and girls may follow different growth trajectories. We use Stata package zscore06.

[45] Stunting, as defined by WHO, reflects long-term malnutrition or cumulative nutrition from conception and is affected by recurrent or chronic illnesses. Wasting represents the failure to receive adequate nutrition in the period immediately preceding the survey. Underweight is a composite index of chronic or acute malnutrition.
WHO health catalogue- https://www.who.int/hac/techguidance/tools/en/Selected%20Health%20Indicators%20.pdf

- antenatal care, measured by whether mothers visited an antenatal care facility at least four times during the pregnancy (as recommended by the WHO) and by the number of months pregnant when the mother first received antenatal care.[46]
- vaccination and immunization, measured in terms of compliance with mandatory vaccinations for polio, BCG, measles, DPT, and vitamin A shot for night blindness[47].
- illness episodes, assessed in terms of episodes of cough, fever and diarrhea occurring within the two weeks prior to the survey.[48]
- mortality, as measured by total fertility up to the time of the survey and neonatal mortality within the first month of birth.
- breastfeeding, as measured by duration in months and indicators of whether the child was breastfed for at least 12, 18 or 24 months. To take into account, the possibility of right-censoring in duration, the indicators are defined conditional on children being at least 12, 18 or 24 months old, respectively, at the time of the survey. The sample is restricted to children alive at the time of the survey.

Since we are looking at multiple outcomes described above, this raises concerns about the over-rejection of null hypotheses unless the multiplicity of the testing framework is explicitly considered (Anderson, 2008; Conti et al., 2016).[49] To address this issue, we adjust for multiple hypotheses testing using the Romano & Wolf (2005) stepdown method.[50] The Romano-Wolf correction uses bootstrap to control for the familywise error rate (FWER) which captures the probability of rejecting at least one true null hypothesis in a family of hypotheses under test. As discussed in Conti et al. (2016) and Heckman et al. (2010), we define blocks of similar outcomes that are selected on a priori grounds.[51]

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[46] Antenatal care visits have been found to be significantly associated with lower rates of birth defects, low birth weight, neonatal infections, and neonatal death (WHO).

[47] Immunization is one of the key interventions for protection of children from life threatening conditions, which are preventable.

Since different vaccinations are administered in different months, the minimum age restriction used in each of the regressions is specified in the first column of Table 3.6.

[48] Illness episodes are useful measures of routine care of children at home (WHO).

[49] Suppose that a single-hypothesis test statistic rejects a true null hypothesis at significance level α. Thus, the probability of rejecting a single hypothesis out of K true hypotheses is given by 1 − (1 − α) K. As the number of outcomes K increases, the likelihood of rejecting a true null hypothesis departs from α (Conti et al., 2016).

[50] Lehmann and Romano (2005) and Romano and Wolf (2005) discuss the stepdown procedure in depth.

[51] The blocks of outcomes for multiple-hypotheses testing is indicated by italicised headings in Table 3.7. We have defined the following blocks of outcomes- anthropometric, antenatal care, immunization, illness episodes, mortality, and breastfeeding practise.

Table 3.7 below reports the results for the various channels linking PSDT and mothers' labour supply discussed above. Column 5 reports the p-values adjusted for multiple hypotheses using the Romano-Wolf stepdown procedure.

In Panel A, we report the estimates for two of the measures of reported son preference defined above. We do not find any effects of PSDT on reported preference towards sons suggesting that the estimates are not driven by trends in son preference over time.

In Panel B, we report estimates for fertility behaviour of mothers and find that access to ultrasound technology reduced the number of daughters born to a mother between the age of 14-30 years by 0.018 and increased the number of sons by 0.016, both statistically significant at the 5% and 1% level, respectively. We find no change in the total fertility suggesting that daughters were substituted for sons subsequent to the availability of sex detection technology.[52] Controlling for mother's fertility preference and son preference does not alter these estimates, suggesting that the estimated coefficients reflect changes in behaviour in response to changes in technology rather than changes in preferences[53]. With respect to fertility within five years of the first birth, we find comparable results. We do not find any effect of PSDT on the birth spacing between the first and second birth suggesting that the changes in the labour supply of mothers are solely due to the substitution of daughters with sons and not because of delays in the following pregnancy.

In Panel C, we report the estimates on the effect of PSDT on various measures of time and material investment in firstborn girls. We find a significant reduction in stunting by 4.9% among firstborn girls, significant at the 10% level, subsequent to the availability of PSDT. However, we do not find any significant effect on wasting and being underweight. However, when we control for multiple hypotheses testing, the estimate on stunting becomes marginally insignificant with a p-value of 0.107.

We also find that antenatal visits increased by 3.2% after the wider availability of PSDT for firstborn girls. Also, the first visit during pregnancy to antenatal care advances by 0.25 months (about a week). The estimates are significant at the 5% and 1% levels, respectively. The estimates

[52] Post liberalization, India saw a decline in total fertility, as measured by a reduction in total live births. We also investigate the changes in total fertility for regions with below and above median son preference separately and find that there was a significant reduction in total fertility post 1995 for both high and low son preferring regions. Results available upon request.

[53] Results available upon request. Controls for son preference included- ideal male to female ratio and whether ideal number of sons more than ideal number of girls.

Table 3.7: Mechanisms linking PSDT and mothers' labour force participation

Outcome Variable	Observations	Triple differences estimate	Std error	Model p-value	Romano-Wolf p-value
	(1)	(2)	(3)	(4)	(5)
Panel A: Changes in son preferences					
Reported ideal MFR >1	13,412	-0.013	(0.019)	0.489	0.680
Standardized reported ideal MFR	13,412	0.0124	(0.033)	0.728	0.755
Panel B: Fertility Behaviour					
Fertility between 14-30 years of age					
No. of boys	126,470	0.016**	(0.008)	**0.047**	**0.025**
No. of girls	126,470	-0.018***	(0.006)	**0.009**	**0.086**
No. of children	126,470	-0.002	(0.01)	0.826	0.813
Fertility within 5 years of first birth					
No. of boys	129,543	0.018***	(0.006)	**0.01**	**0.031**
No. of girls	129,543	-0.014**	(0.007)	0.059	**0.014**
No. of children	129,543	0.005	(0.007)	0.459	0.470
Birth spacing between first and second birth					
Birth spacing *after first birth*	22,229	0.306	(0.40)	0.452	-
Panel C: Investment in firstborn girls relative to boys post PSDT					
Anthropometric outcomes					
Stunt	10,429	-0.048*	(0.025)	**0.063**	0.107
Underweight	11,538	0.002	(0.017)	0.924	0.989
Wasted	10,259	0.001	(0.033)	0.972	0.989
Antenatal visits					
At least 4 antenatal visits	13,120	0.033*	(0.018)	**0.089**	**0.033**
Month- first antenatal visit	10,488	-0.256***	(0.082)	**0.005**	**0.008**
Vaccinations					
Polio (>=6 months)	6,724	0.005	(0.017)	0.745	0.922
BCG (>=6 months)	9,565	0.000	(0.019)	0.992	0.995
Measles (>=12 months)	6,454	0.030	(0.026)	0.254	0.509
DPT (>=6 months)	9,516	0.033*	(0.018)	**0.074**	0.226
Vitamin A for nigh blindness (>=12 months)	6,267	0.114**	(0.054)	0.136	0.346
Illness episodes					
Fever	12,464	-0.035**	(0.014)	**0.026**	**0.044**
Cough	12,463	-0.012	(0.019)	0.533	0.468
Diarrhea	12,465	-0.026***	(0.009)	**0.006**	**0.023**
Mortality					
Total mortality	13,412	-0.017**	(0.008)	**0.034**	**0.070**
Neonatal mortality (<=1 month)	13,412	-0.014	(0.008)	0.104	0.105
Breastfeeding					
Breastfeeding duration	12,448	-0.133	(0.198)	0.507	-
At least 12 months	6,552	0.004	(0.020)	0.832	-
At least 18 months	3,487	-0.018	(0.057)	0.756	-
At least 24 months	1,126	-0.084	(0.081)	0.257	-

Notes: Column (1) reports the sample size; column (2) reports the coefficient of the triple interaction from DDD. All the regressions include controls.[54] *Standard errors are clustered at the state level and data are weighted using population-level weights; column (3) reports the standard errors associated with column (2); column (4) displays the p-value associated with column (2); and column (5) displays the multiple-hypotheses testing (Romano & Wolf stepdown) p-values associated with column (2) using 1000 bootstrap replications.* The blocks of outcomes for multiple-hypotheses testing is indicated by italicised headings.

on antenatal care for firstborns provide suggestive evidence that availability of ultrasound resulted in increased antenatal check-ups for firstborn girls but as discussed in section 3.4 before, male to female ratio for firstborns was well within the normal range, and parents did not eliminate girls at the first parity.

We find an improvement in DPT vaccinations of 3.3%, significant at the 10% level, among firstborn girls post PSDT but no effect on polio, BCG, and measles vaccinations. However, when controlling for multiple hypotheses testing, none of the estimated effects is significantly different from zero.

There is a reduction in fever and diarrhea episodes of firstborn girls post PSDT. Fever episodes reduce by 3.5% and episodes of diarrhea decreased by 2.6%, significant at the 5% and 1% levels, respectively. We also control for the seasonality of illness episodes by controlling for the month of the interview and the estimates remain unchanged. Results are robust to multiple hypotheses testing.

We also observe a fall in total mortality by 1.7% among firstborn girls post PSDT, significant at the 5% level, respectively and robust to multiple hypotheses testing. We do not find any effect of PSDT on breastfeeding practices for firstborn girls.

We interpret the findings on improved material investment in firstborn girls as improved time investment in them, especially for economically weaker families. Poorer families generally have

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[54] For all outcomes in Panel A, we include controls for mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence, and state fixed effects.

For all outcomes in Panel B, we include controls for year of firstborn birth, mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence, and state fixed effects.

For all outcomes in Panel C, except for the mortality outcomes, we include controls for child's age in months, mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence, state fixed effects, and child's age- gender fixed effects.

For mortality outcomes we include controls for child's year of birth, mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence, and state fixed effects.

Observations are weighted using national-level weights and standard errors are clustered at the state level.

access to public hospitals and clinics because of free healthcare facilities but these facilities are located at a greater distance from residential areas and have long waiting times. There is also an opportunity cost to visit hospitals for the poor who have to miss their daily wage.

3.6 Conclusion

With the liberalization of the Indian economy and following the acceleration of the domestic production of ultrasound machines, since the mid-1990s Indian households experienced a sudden increase in the availability of prenatal sex detection technology (PSDT). The low cost and the non-invasive nature of ultrasound scans led to their widespread use for fetal sex determination. Due to the stark preferences of Indian families towards having sons, this resulted in a staggering rise in female feticide and eventually, an increase in the male to female sex ratios at birth from 964 girls born for every 1000 boys in 1971 to 927 girls in 2001. The resulting scarcity of girls has been found to have consequences on violence against women, marriage market imbalance, prostitution, and sexually transmitted diseases, among others. In this paper, we investigate the effect of the wider availability of PSDT on mothers' labour supply in India.

Using the triple differences technique, we exploit supply-driven changes in the availability of ultrasound technology interacted with the quasi-random family-level incentive to conduct sex selection and local level proclivity to carry out sex selection. We find that the increased availability of PSDT has led to a reduction of mothers' labour supply.

Exploration of channels linking prenatal sex selection and mothers' labour supply shows that access to prenatal sex detection gave mothers more control over the sex composition of children and resulted in improvement in investment in firstborn girls. We find that subsequent to the availability of PSDT there was a differential reduction in the number of daughters and an increase in the number of sons in the family, as daughters were selectively aborted and replaced with sons. We postulate that the resulting substitution of unwanted girls with sons reduces expected dowry payments in the future and thus, reducing the financial need for mothers to work. The existing literature documents that Indian mothers invest more time in sons than daughters and in response to having more sons in the family mothers reduce their labour supply. We do not find any significant differential effect of PSDT on total fertility and birth spacing between the first and second birth suggesting that mothers after undergoing abortion if the foetus is a girl, go on directly to the next pregnancy for a son, resulting in reduced labour supply.

Consistent with the literature that scarcity of girls changes their value in labour and marriage markets, subsequently affecting parental incentives to invest in girls, we find that access to the sex-selection technology led to a reduction in postnatal mortality, the incidence of stunting, illness episodes and improvement in immunization and vaccination for firstborn girls. Recent papers find improved investment in existing girls post the availability of sex selection technology (Anukriti et al., 2021; Hu & Schlosser, 2015). We postulate that scarcity of girls due to more control over following pregnancies and gender of children subsequent to the availability of PSDT, results in an improved relative preference for existing firstborn girls, consequently, resulting in increased investment in girls and thus, attenuating the differences in labour supply of mothers with girls vs boys through increased mothers' time investment. Another plausible explanation could be that mothers improve time investment in firstborn girls, by reducing their labour supply, because these girls are a potential source of informal childcare for future expected sons. Overall, our findings suggest that the availability of prenatal sex detection technology may have contributed to the decline in female participation observed since the 1990s.

3.7 Appendix

Table A3.1: Robustness check- controls for state-time and state-firstborn gender fixed effects

Dep var-Mothers' labour force participation	**(1)**	**(2)**	**(3)**
Firstborn girl × post × z-local MFR in 1981	-0.022*		
	(0.011)		
Firstborn girl × post × z-growth in state MFR between 1981 and 1991		-0.030***	
		(0.009)	
Firstborn girl × post × z-local ideal MFR			-0.020***
			(0.005)
Observations	13,412	13,412	13,412
R-squared	0.173	0.172	0.173
Mean	0.222	0.222	0.222

*Notes: Robustness check- Specification controls for state-time and state-firstborn gender fixed effects. All the specifications control for mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence and state fixed effects. Standard errors are clustered at the state level. and are reported in parenthesis. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table A3.2: Robustness checks- individual son preference

Dep var-Mothers' labour force participation	**(1)**
Firstborn girl × post × Individual Son Preference	-0.073***
	(0.024)
Observations	13,412
R-squared	0.171
Mean	0.222

*Notes: Robustness check- Specification uses individual-level son preference as a third difference. Individual son preference takes a value of 1 if the reported ideal male to female ratio is >1, and 0, if the reported ideal male to female ratio is <=1. All the specifications control for mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence and state fixed effects. Standard errors are clustered at the state level. and are reported in parenthesis. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table A3.3: Robustness check- median split of regional son preference

Dep var-Mothers' labour force participation	(1)	(2)	(3)
Firstborn girl × post × median-local MFR in 1981	-0.036**		
	(0.017)		
Firstborn girl × post × median-growth in state MFR between 1981 and 1991		-0.043***	
		(0.013)	
Firstborn girl × post × median- local ideal MFR			-0.062***
			(0.011)
Observations	13,412	13,412	13,412
R-squared	0.170	0.169	0.176
Mean	0.222	0.222	0.222

*Notes: Robustness check- Specification uses median split of regional son preference as a third difference. All the specifications control for mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence and state fixed effects. Standard errors are clustered at the state level. and are reported in parenthesis. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

Table A3.4: Robustness check- including mothers with first births in 1990 and 1996

Dep var-Mothers' labour force participation	(1)	(2)	(3)
Firstborn girl × post × z-local MFR in 1981	-0.017**		
	(0.008)		
Firstborn girl × post × z-growth in state MFR between 1981 and 1991		-0.026***	
		(0.006)	
Firstborn girl × post × z-local ideal MFR			-0.009
			(0.006)
Observations	19,216	19,216	19,216
R-squared	0.167	0.167	0.167
Mean	0.230	0.230	0.230

*Notes: Robustness check- Regressions include mothers with first births in 1990 and 1996 to increase the sample size. All the specifications control for mothers' age, age at first marriage, age at first birth, marital status, education level, husband's education, wealth quintiles, religion, type of residence and state fixed effects. Standard errors are clustered at the state level. and are reported in parenthesis. * Indicates statistical significance at 10%. ** Indicates statistical significance at 5%. *** Indicates statistical significance at 1%.*

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